



# ERDC

Engineer Research and  
Development Center

## Nearshore Placement Webinar: Nearshore Placement Research & Development

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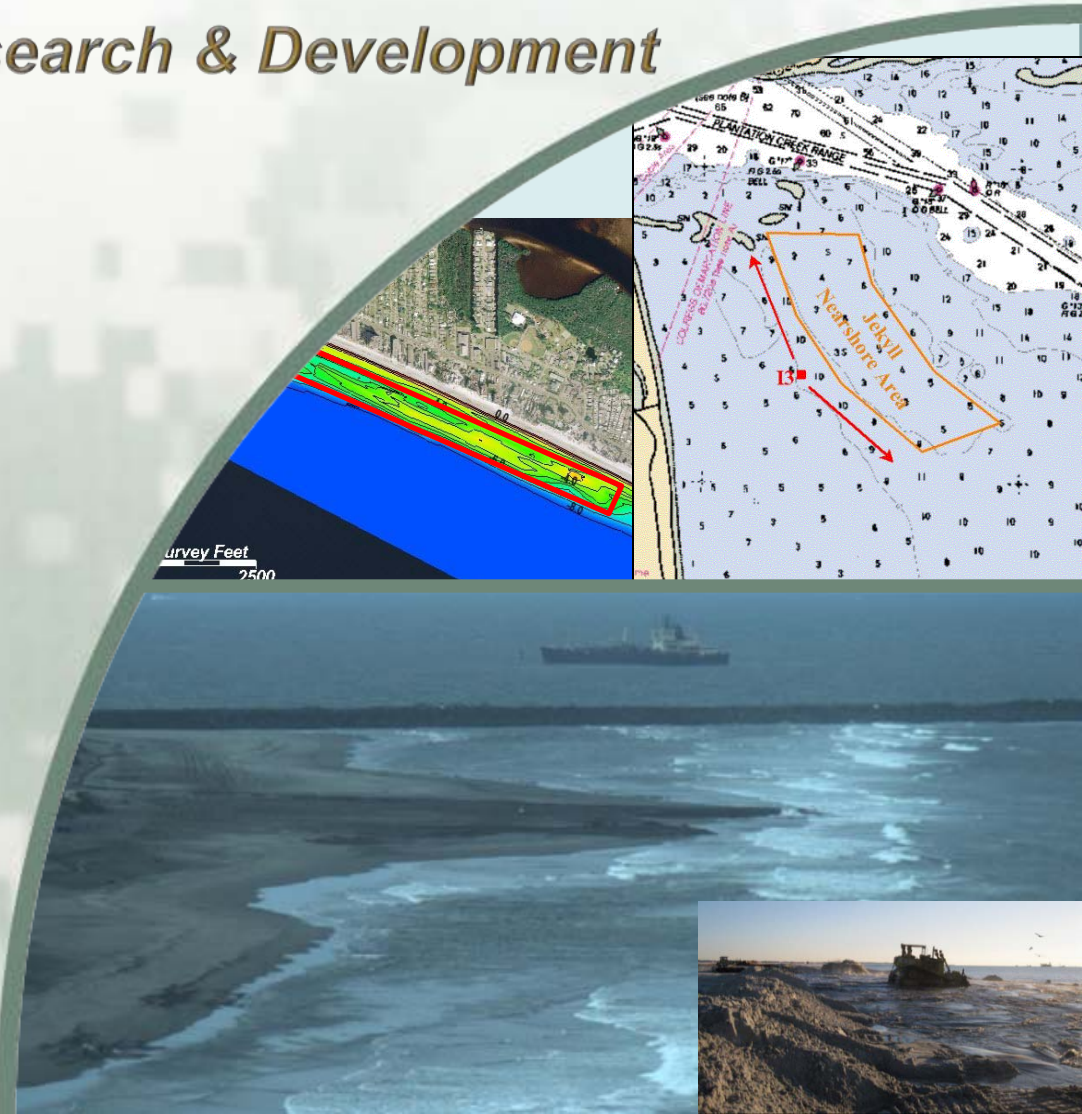
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*Regional Sediment Management (RSM),  
Dredging Operations Research (DOER), &  
Coastal Inlets Research Programs (CIRP),  
Nearshore Berms R&D*



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# Agenda

## Overview

**All times Eastern**

<b>1:30 PM – 1:40 PM</b>	Opening Business/Introductions
<b>1:40 PM – 2:10 PM</b>	Risk and Regulatory/Permitting
<b>2:10 PM – 2:40 PM</b>	Measurement Capabilities
<b>2:40 PM – 2:50 PM</b>	<i>Break</i>
<b>2:50 PM – 3:20PM</b>	Modeling Techniques
<b>3:20 PM – 3:45 PM</b>	Recent Studies
<b>3:45 PM – 4:00 PM</b>	Discussion & Closing



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# Goal of this Webinar Series

- **Initiate a Nearshore Placement Community within USACE**
- **Facilitate discussion on a focused topic**
- **Interface for District to District, and District to ERDC**
- **Provide a starting point for successive webinars on other related topics**
  - **“Strategic Placement → Nearshore Placement → Nearshore Berms” = One example of Dredged Material Management**
- **Follow-up topics could include:**
  - **Permitting issues and strategies to move forward**
  - **Further discussion of the available measurement and modeling tools**
  - **Long-term viability of nearshore placement sites**



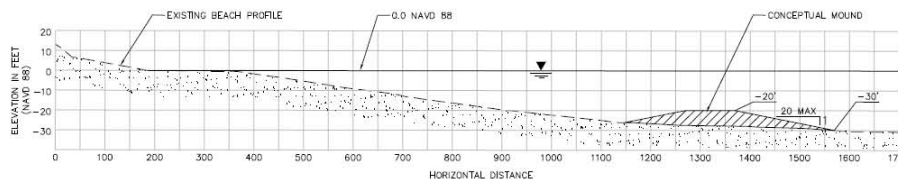
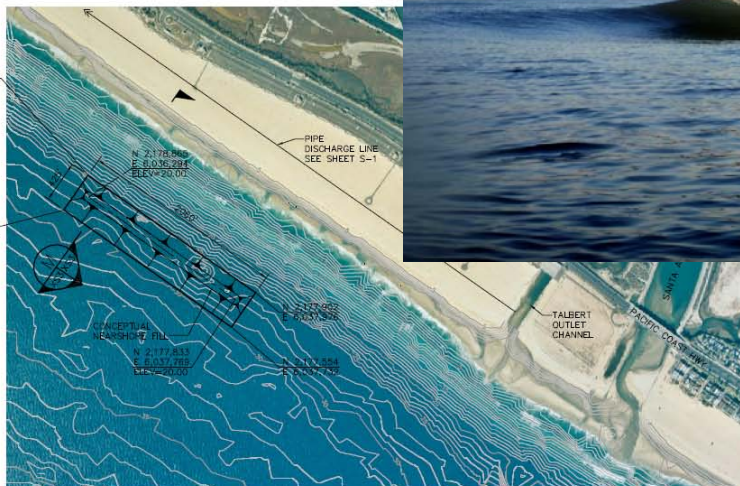


# Nearshore Berms Examples

## Small Dispersive Placements

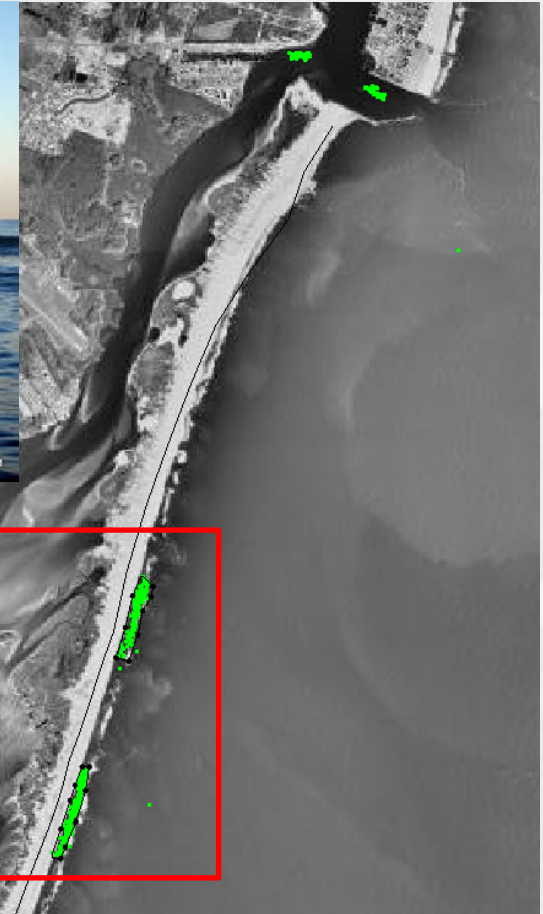


Shark River Inlet (NAB)



Huntington Beach (SANDAG)

Positive  
Recreational  
Feature



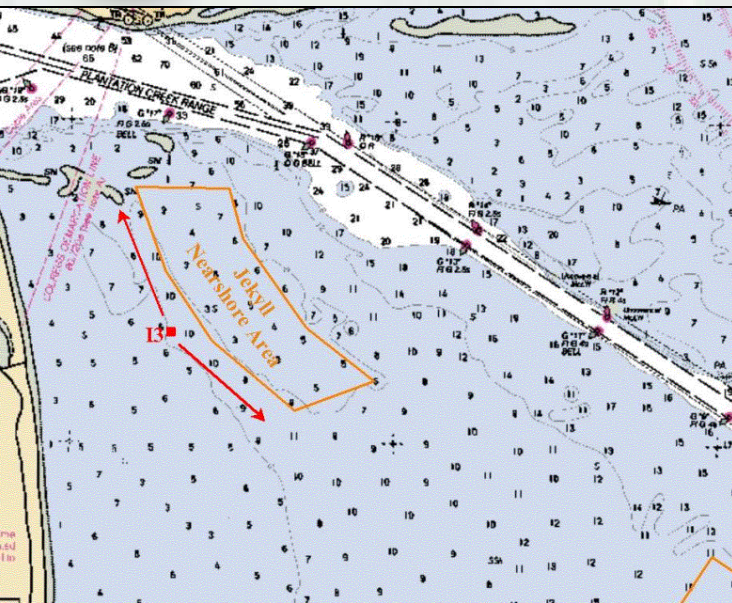
Assateague Island, MD  
(NAB)

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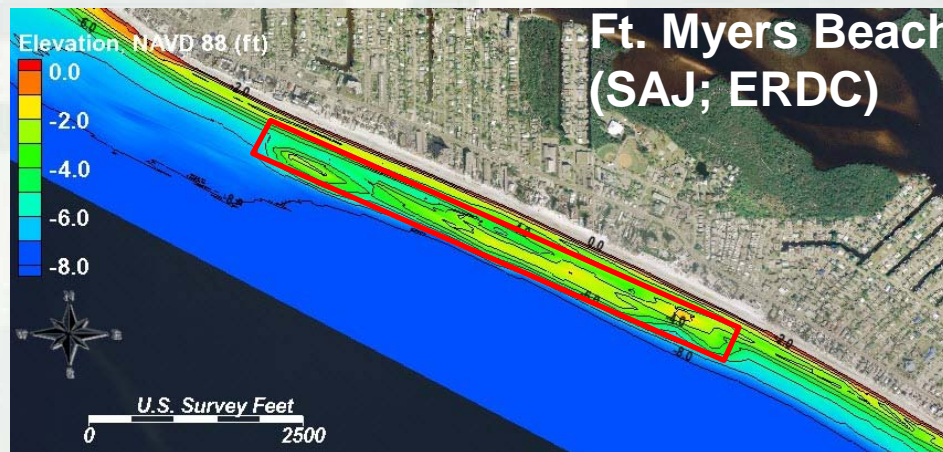


# Nearshore Berms Examples

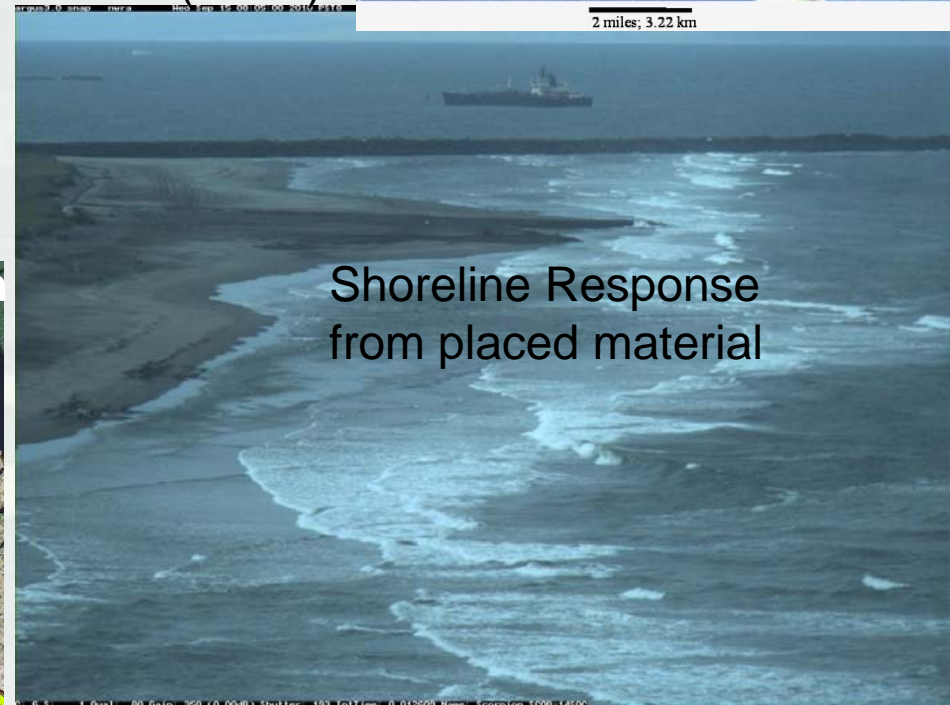


Brunswick  
(SAS;  
DOER)

Benson Beach  
Beneficial Use  
Placement  
(NWP)



Ft. Myers Beach  
(SAJ; ERDC)



Shoreline Response  
from placed material



# Risk and Regulatory/Permitting Discussion



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## **Strategic Placement in the Nearshore Risk, Regulatory, and Permitting**

John L. Childs, P.E. Research Engineer

Jennifer M. Gerhardt Smith, Research Biologist

**Environmental Laboratory**

**29 November 2012**



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# Risk, Regulatory, and Permitting

- Risk
  - ▶ Site Model to determine:
    - *Potential Impacts to Water Column*
    - *Potential Impacts to Benthos*
    - *Potential Impacts by Benthic Bioaccumulation*
  - ▶ *Engineering and Operational Controls*
- Regulatory
- Permitting
- Depth of Closure
- Beneficial Use





# Technical Guidance for Management of Dredged Material



## *USEPA and USACE 2004* Evaluating Environmental Effects of DM Management Alternatives (33CFR 336.1) (A Technical Framework)

### ***USEPA/USACE 1991***

**Marine Protection  
Research and  
Sanctuaries Act**

**Ocean Testing  
Manual**

### ***USEPA/USACE 1998***

**Clean Water Act**

**Inland Testing  
Manual**

### ***USACE 2003***

**Five Risk Pathways  
for CDFs**

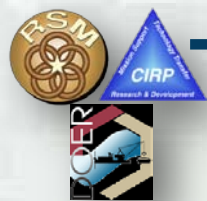
**Island, Nearshore,  
or Upland Testing  
Manual**



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# Technical Guidance for Management of Dredged Material



*USEPA and USACE 2004*  
Evaluating Environmental Effects of  
DM Management Alternatives (33CFR 336.1)  
(A Technical Framework)

*USACE and USEPA*  
**Aquatic Placement of Dredged  
Material: Testing, Evaluation,  
Assessment, and Management  
Manual (TEAMM)**

*USACE 2003*  
**Five Risk Pathways  
for CDFs**  
**Island, Nearshore,  
or Upland Testing  
Manual**

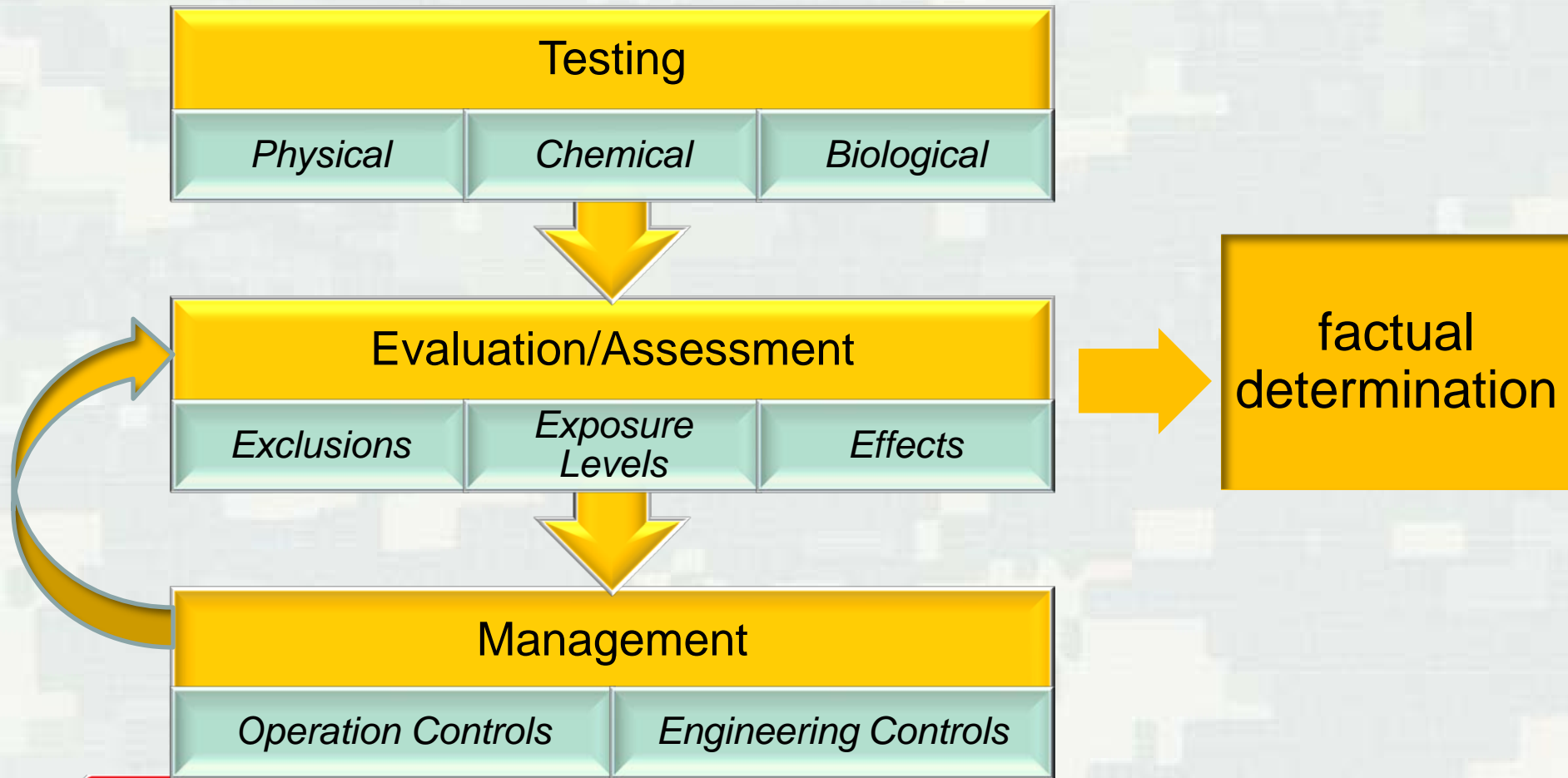


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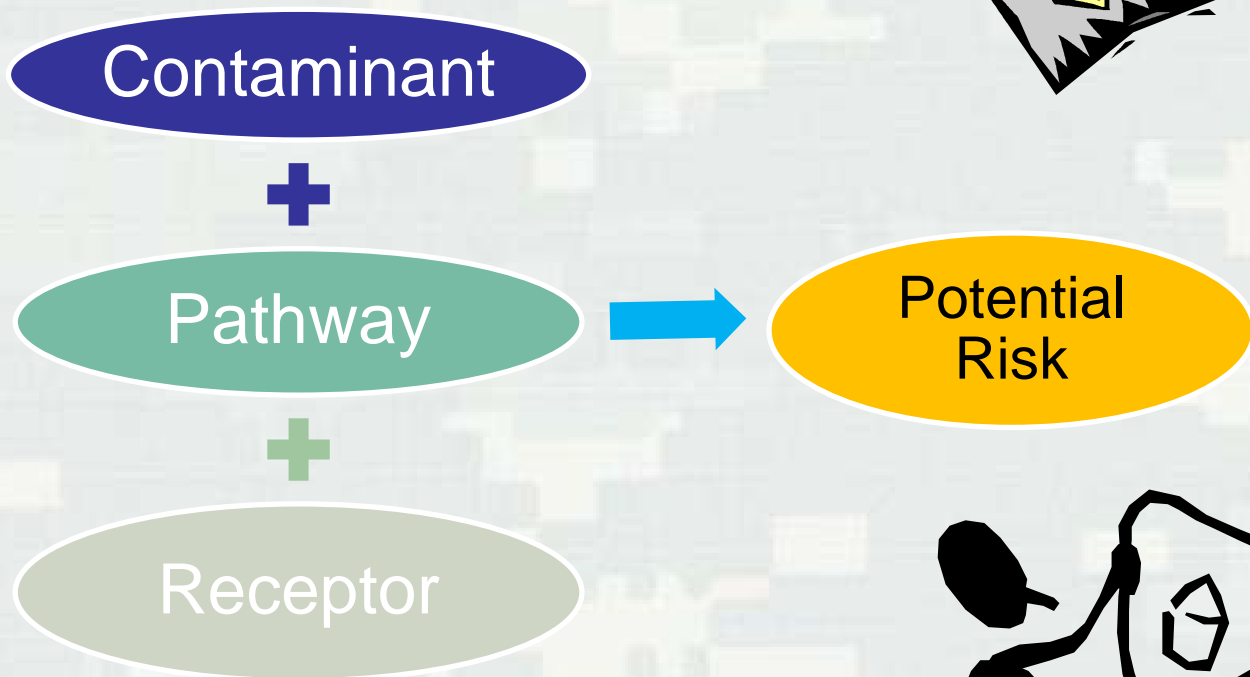
# Risk Evaluation with Risk Management





# Site Models for Risk Characterization

...can be written description or visual representation that depicts project-specific conditions...



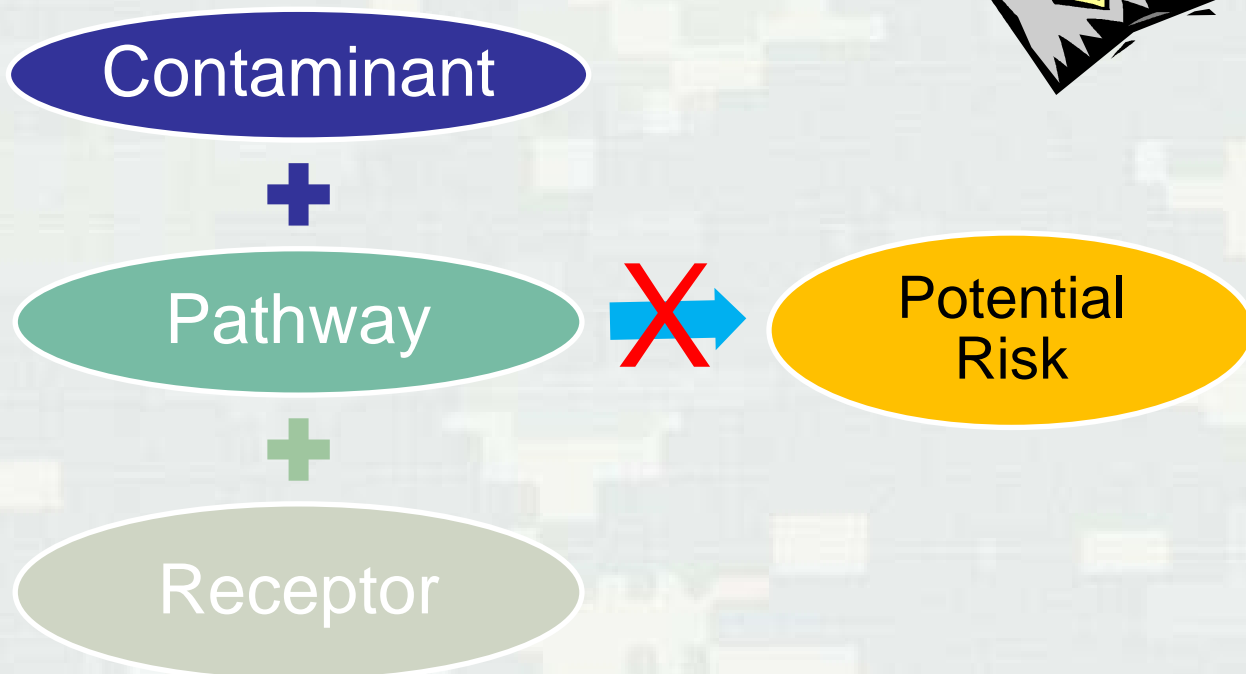
"...are abstractions of reality created to express a general understanding of a more complex process or system," Fischenich 2006





# Site Model for Risk Management

“Risks can be minimized by reducing either their likelihood or their impact” Suedel, et al. 2012



where there is adequate justification to show that widespread dispersion by natural means will result in no significantly adverse environmental effects, discharged material may be intended to be spread naturally in a very thin layer over a large area 40CFR 230.11(f)





# Dredged Material Placement Scenarios for TEAMM

- Scenario 1- Barge or hopper release in open water (ocean and inland)
- Scenario 2- Pipeline placement in open water (ocean and inland)
- Scenario 3- Strategic placement nearshore or onshore for beneficial use (coastal and inland)
- Scenario 4 - Open water placement then capped (Level Bottom Cap or Confined Aquatic Disposal )
- Scenario 5 - Agitation dredging for RSM (hopper overflow or flow-lane placement)

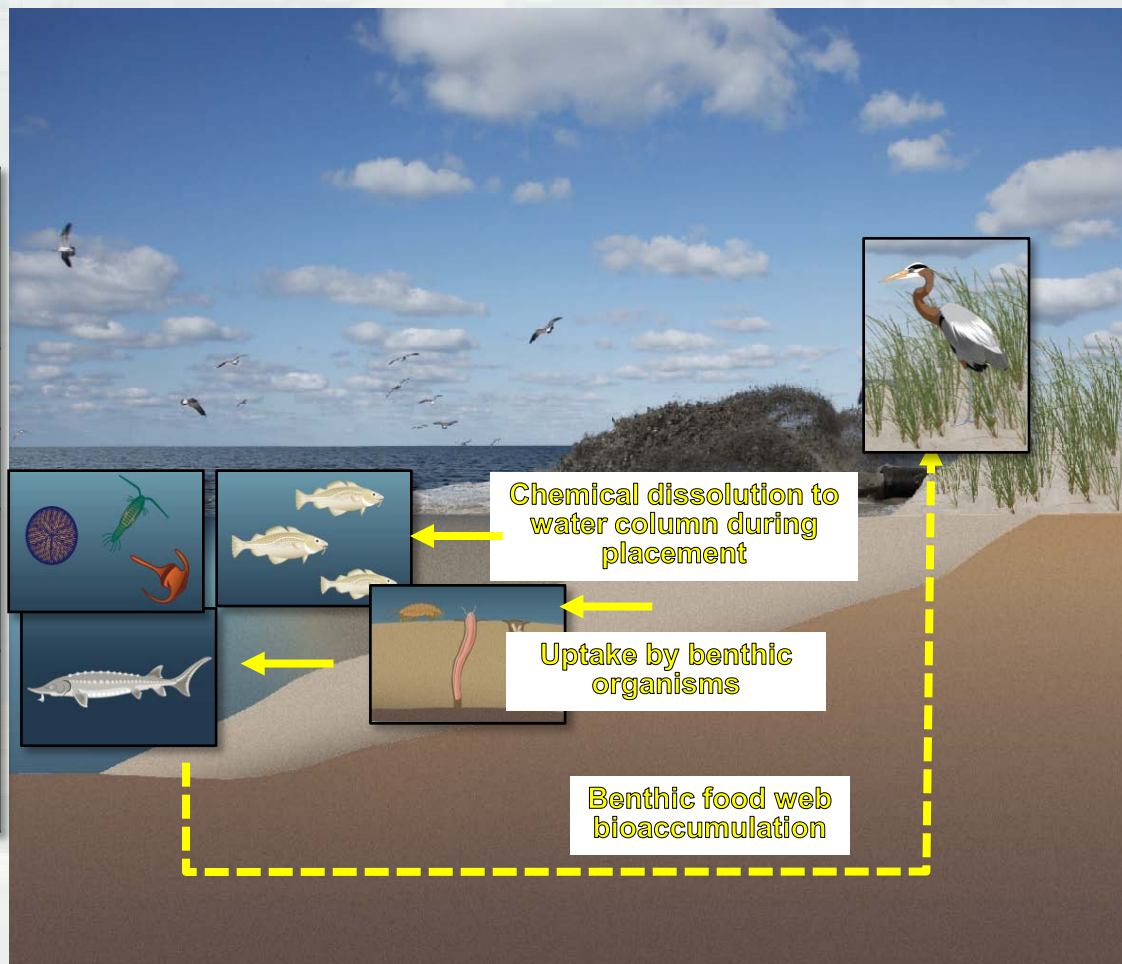




Strategic placement  
nearshore or onshore  
for beneficial use

## TEAMM CSM-Scenario 3

Potential Receptors	Completed Exposure Pathway?
Water column	Yes ?
Benthic Toxicity	Yes ?
Fish and aquatic wildlife	Yes ?
Terrestrial wildlife and humans	Possibly



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# Management of Water Column Effects

## ***Operational Controls***

- Reduce release rate
- Depth of release
- Release under tow
- Increase overflow to reduce water content

## ***Engineering Controls***

- Submerged diffuser
- Tremie tube
- Dredge type
- Silt curtain
- Amend sediment or water column





# Management of Benthic Toxicity & Bioaccumulation

## ***Operational Controls***

- Schedule placement based on conditions
- Sequence placement—cleaner material on top

## ***Engineering Controls***

- Amend sediment to reduce desorption
- Lateral confinement
- Capping
- Enhanced MNR





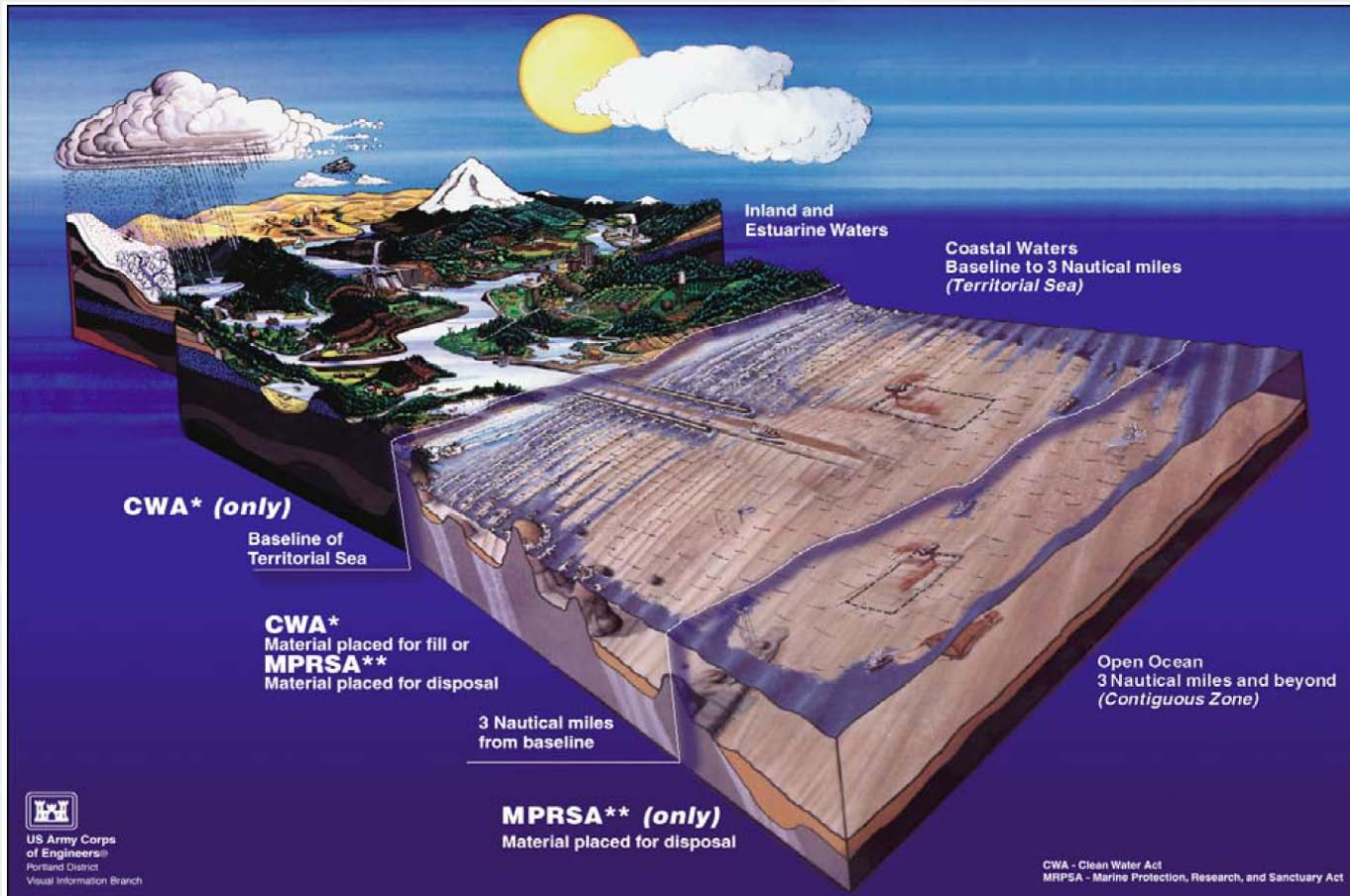
# Strategic Placement in the Nearshore Regulations - Permitting

- Rivers and Harbors Act – Sec. 10
- National Environmental Policy Act – Sec. 102
- Fish and Wildlife Coordination Act
- Endangered Species Act
- Coastal Zone Management Act – Sec. 307(c)
- Marine Protection, Research, and Sanctuaries Act (Ocean Dumping Act) – Sec. 103
- Federal Water Pollution Control Act (Clean Water Act) – Secs. 404 and 401





# Strategic Placement in the Nearshore Regulations - Permitting



US Army Corps  
of Engineers  
Portland District  
Visual Information Branch



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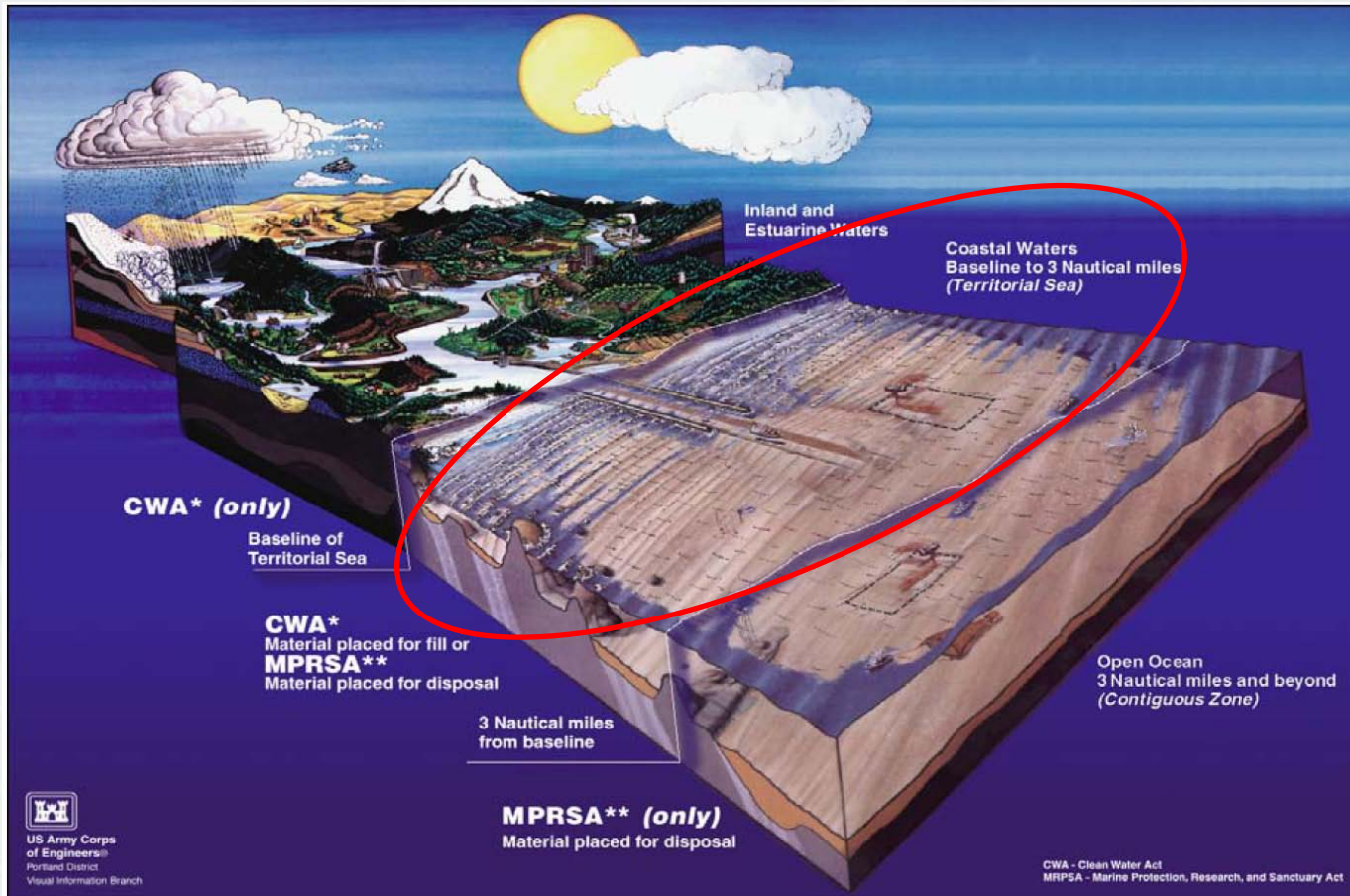
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# Strategic Placement in the Nearshore Regulations - Permitting





# Strategic Placement in the Nearshore

## ODA vs. CWA

- 33 CFR Part 336 — Factors to be considered in the evaluation of USACE dredging projects involving the discharge of dredge material into waters of the U.S. and ocean waters.
- (a) The disposal into ocean waters, including the territorial sea, of dredged material ... will be evaluated by the Corps in accordance with the ODA.  
(\*\*\*also requires a 401 WQC)
- (b) In those cases **where the District Engineer determines that the discharge of dredged material into the territorial sea would be for the primary purpose of fill**, such as the use of dredged material for beach nourishment, island creation, or the construction of underwater berms, the discharge will be evaluated under Section 404 of the CWA.





# Strategic Placement in the Nearshore

## CWA – Sec. 404

- **Fill material.** (40 CFR Part 232.2)
  - ▶ Material placed in waters of the U.S. **where the material has the effect of:**
    - Replacing any portion of a water of the U.S. with dry land; or
    - **Changing the bottom elevation of any portion of a water of the U.S.**
- **Discharge of fill material.** (40 CFR Part 232.2)
  - ▶ **The addition of material** into waters...generally includes, without limitation, the following activities: Placement of fill **that is necessary for the construction of any structure or infrastructure... requiring rock, sand, dirt, or other material** for its construction... dams and dikes, artificial islands, property protection and/or reclamation devices such a rip rap, groins,... beach nourishment, levees...
- **404(b)(1) Guidelines** (40 CFR Part 230)





# Strategic Placement in the Nearshore CWA 404 Information Needs

Must prove that what we propose:

- 1) Meets the 404(b)(1) Guidelines on effects
- 2) Is fill (40 CFR)
- 3) Is a discharge of fill material - “the **addition of material** into waters...generally includes, without limitation, the following activities: Placement of fill **that is necessary for the construction of any structure or infrastructure... requiring rock, sand, dirt, or other material** for its construction... dams and dikes, artificial islands, property protection and/or reclamation devices such a rip rap, groins,... beach nourishment, levees... (40 CFR)
- 4) The discharge is for the **primary purpose** of fill (33 CFR - Substantiate DE’s assertion)







# Strategic Placement in the Nearshore CWA 404 Information Needs

Must prove that what we propose:

- 1) Meets the 404(b)(1) Guidelines for effect assessment
- 2) Is fill (40 CFR)
- 3) Is a discharge of fill material - “the **addition of material** into waters...generally includes, without limitation, the following activities: Placement of fill **that is necessary for the construction of any structure or infrastructure... requiring rock, sand, dirt, or other material** for its construction... dams and dikes, artificial islands, property protection and/or reclamation devices such a rip rap, groins,... beach nourishment, levees... (40 CFR)
- 4) The discharge is for the **primary purpose** of fill (33 CFR - Substantiate DE’s assertion)

Information Needs:

- Effect Assessment (40 CFR Part 230)
- Need proof of concept the discharge is for an activity/construction
- Need to show discharged material is “predominantly” fill material (not disposed material)
- Typically interpreted as 50% + 1 grain must serve primary purpose of fill





# Strategic Placement in the Nearshore CWA 404 Lines of Evidence

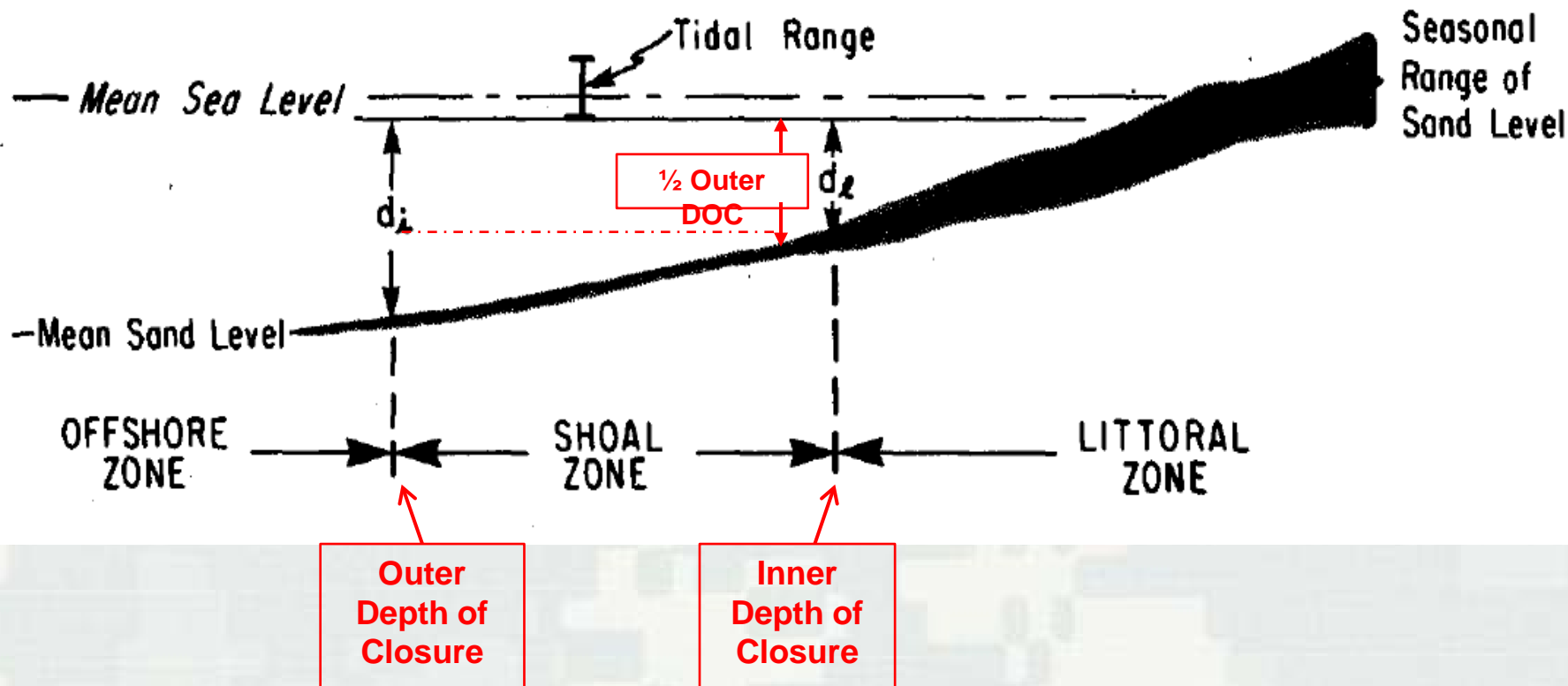
## Challenge to Engineers and Scientists:

- ▶ **Keep us away from the ODA!**
  - Site Designation= Cost, Time, Unlikely, Lost Resource, Missed Opportunity = HEADACHE
- ▶ Show that more than half of the material (fill) is expected to serve the construction activity (contribute to purpose).
- ▶ Need LINES of EVIDENCE for:
  - ▷ Right Sediment Composition
    - Material Characterization – Aquatic Placement of DM TEAMM
  - ▷ Right Placement/Construction Method & Location
    - Experience – Monitoring of Completed Projects
    - Site Specific Data & Models
    - Other Agreed Upon Criteria



# Placement Nearshore to meet CWA 404

Figure (adapted from Hallermeier, 1981)





# Dredged Material = SEDIMENT

## SEDIMENT is a RESOURCE

**Corps 1987 EM 1110-2-5026:** *Beneficial Use is utilizing dredged material as a resource in a productive way, which provide environmental, economic, and/or social benefits.*

**National Dredging Team's Dredged Material Management: Action Agenda for the Next Decade (2003):** Much of the sediment dredged each year could be used in a beneficial manner, such as habitat restoration and creation, beach nourishment, and industrial and commercial development; yet much of this dredged material is disposed in open water, confined disposal facilities, and upland disposal facilities; Beneficial use must become a priority at all levels of management and there must be recognition that dredged material is a valuable resource (EPA 2003).





# Dredged Material as a Resource: Measurements and Modeling

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# Corps sediment management needs

- Corps infrastructure often alters natural movement of sediment
- Changes to transport patterns have both positive and negative impacts
- RSM/EwN Goals
  - ▶ Minimize negative impacts
  - ▶ Maximize benefits
  - ▶ Reduce costs to maintaining infrastructure, safety, and business line missions
  - ▶ Dredged sediment as a resource



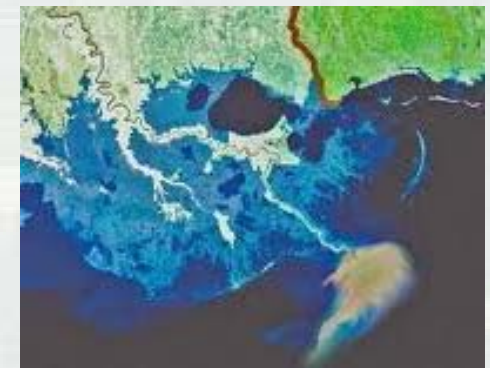
# Sediment Transport Issues



Maintain Navigation



Effects of Structures



Land Loss/morphology



Regulation and effects on species/habitat

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Event Sedimentation and Erosion



Dredged sediment as a resource/RSM

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# Dredged material as a resource: Nearshore Berms

- Dispersive Berms
  - ▶ Nourish sandy shorelines
  - ▶ Provide mineralogical sediments to wetlands or other habitat
- Stable Berms
  - ▶ Protect habitat, coastline, infrastructure
  - ▶ Create features suitable for colonization
- This presentation: nourish sandy shorelines





# Dredged material as a resource: Nearshore Berms

- Objectives:
  - ▶ Permit fines/sand to winnow
  - ▶ Migration of sand to the beach
  - ▶ Transport of fines away from beach
  - ▶ Sustainable DMM solutions
- General Issues:
  - ▶ Fate of sand and fines
  - ▶ Regulatory compliance
  - ▶ Effects on local habitat/resources
  - ▶ Minimize cost while providing most benefit





# Nearshore Berms: Sustainable DMM Solutions

- Need to balance multiple objectives
  - ▶ Provide designated benefits (sand, habitat, etc)
  - ▶ Minimize risk of negative impacts (WQ, eg)
  - ▶ Cost effective
  - ▶ Sustainable (can reuse the site effectively in DMM solutions)
- In general, measurements and modeling are required to address:
  - ▶ Regulatory approval
  - ▶ Optimize sand supply - assess alternatives
  - ▶ Support risk assessment







# Measurements and Modeling

- The majority of sediments handled by USACE at entrance channels are mixtures of sand, silt, and clay
- Measurements and modeling permit us to develop multiple LOEs to effectively manage mixed sediment
- Development efforts:
  - ▶ Improve measurement/monitoring methods
  - ▶ Improve mixed sediment transport algorithms
  - ▶ Improve site-specific parameterization methods





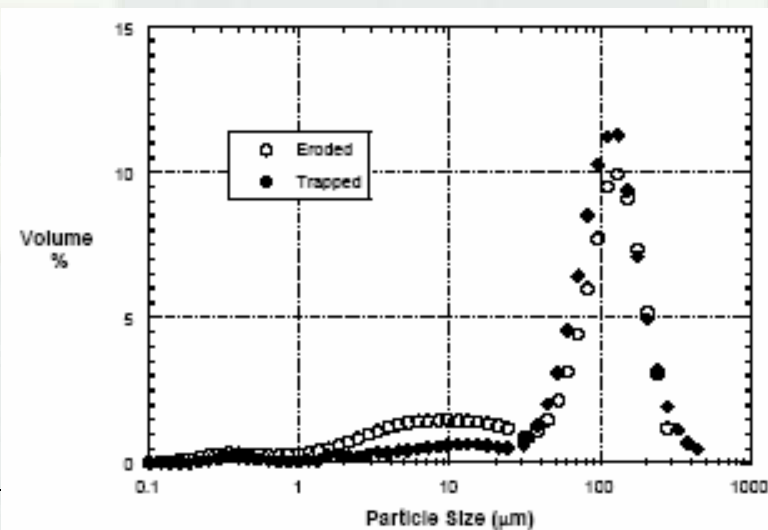
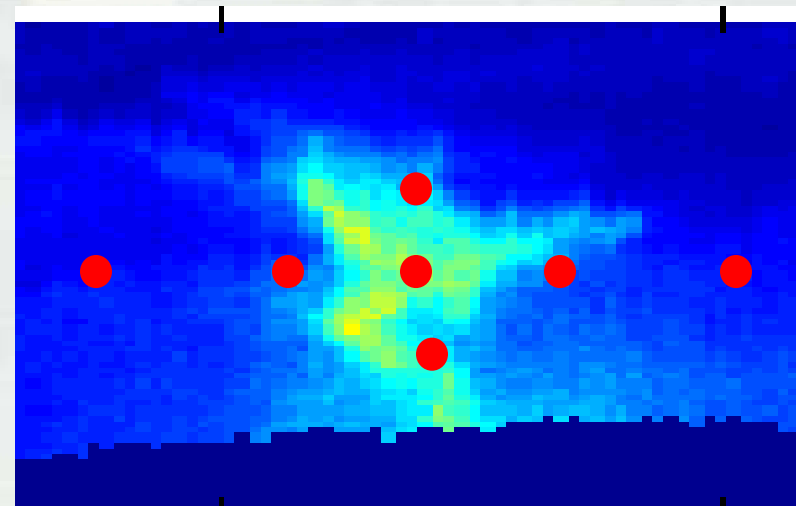
# How are measurement used?

- Understand how sand, silt, and clay transport in a system (CSM)
  - ▶ Range from particle- to system-scale
  - ▶ Determine dominant transport processes/events
  - ▶ Data are used in models to represent transport processes
- Parameterize, calibrate, validate model(s)
- Monitoring data used to assess regulatory compliance, refine CSM
- Validated models used to assess alternatives, evaluate risk



# What do we measure/monitor?

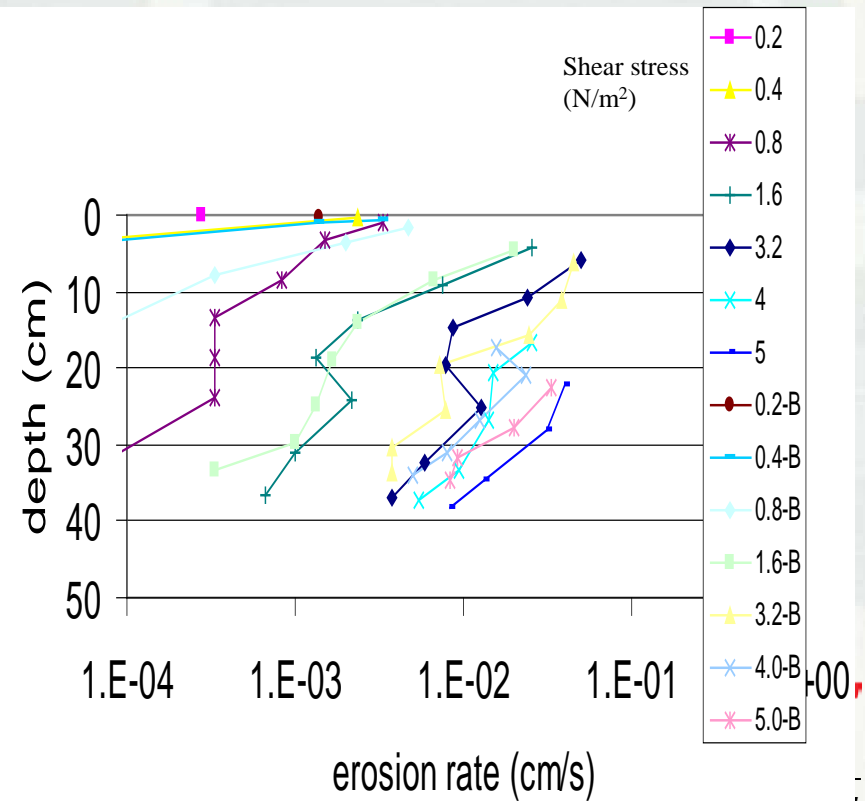
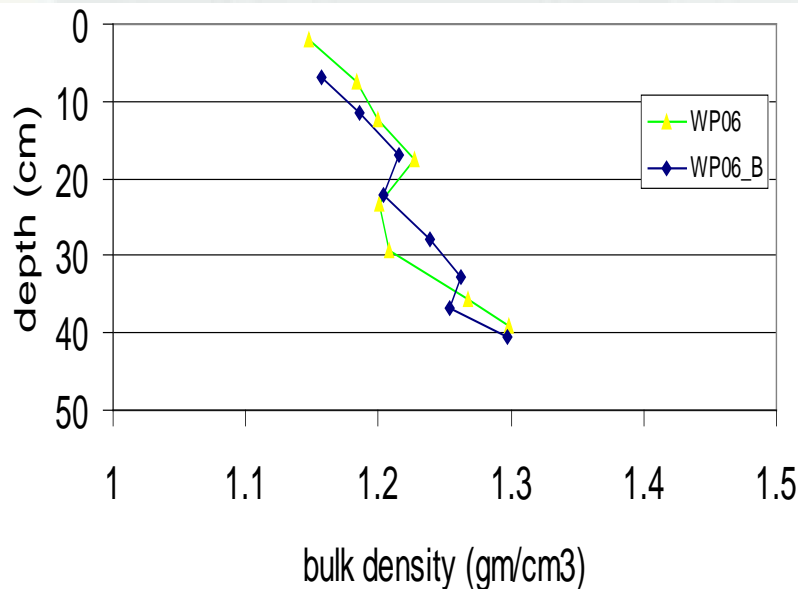
- Full suite of hydrodynamic conditions (tide, currents, waves, salinity,...)
- Process measurements
  - ▶ Erosion potential
  - ▶ Sediment settling (deposition/sedimentation)
  - ▶ Bed consolidation
- Sediment bed composition
- Water column concentration



Morphologic evolution

# Erosion with depth

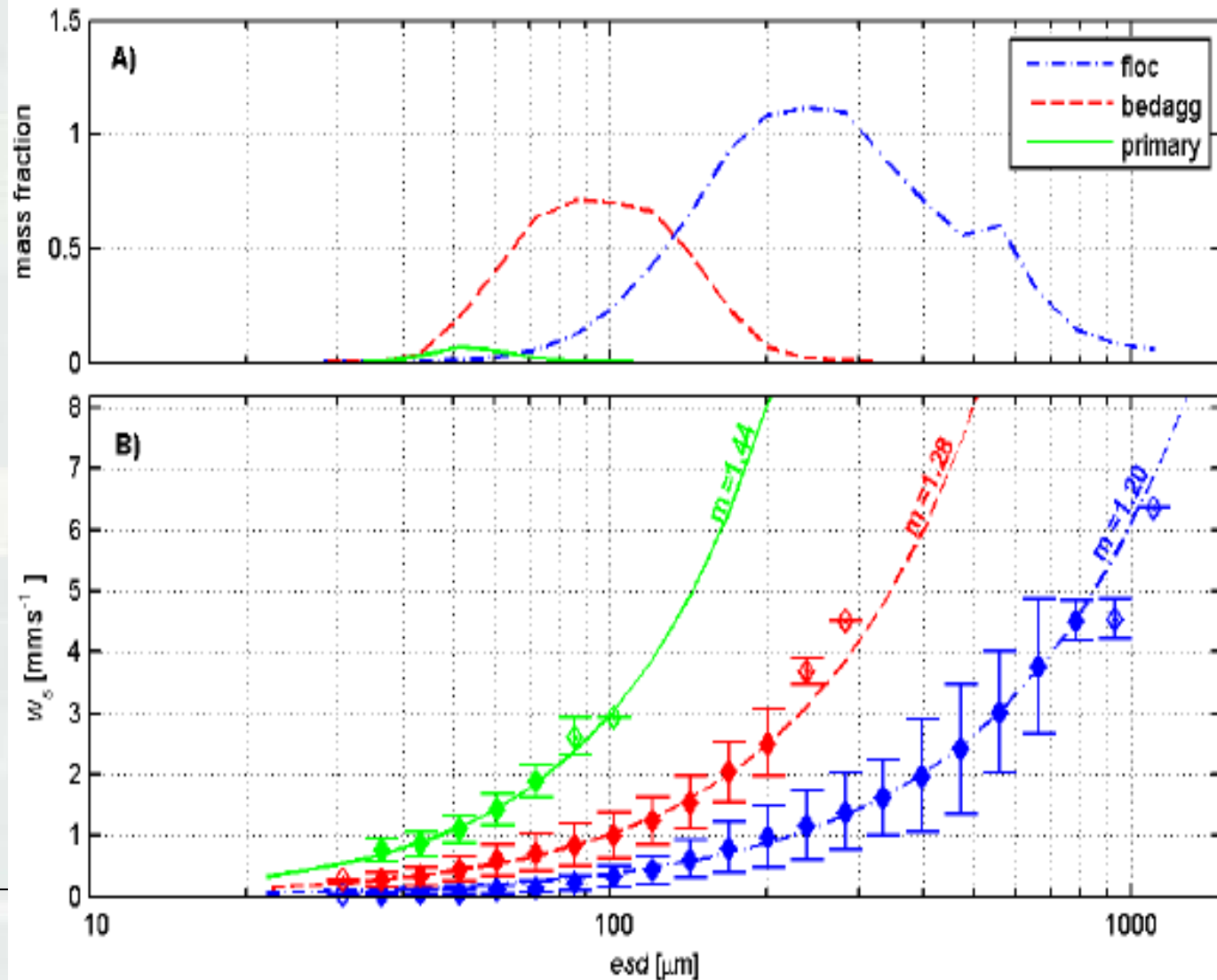
- Why make these measurements?
  - Erosion of mixed sediment mounds is a function of density, other factors
  - Must understand under what conditions surface- and sub-layers will move
  - Used to parameterize and calibrate models





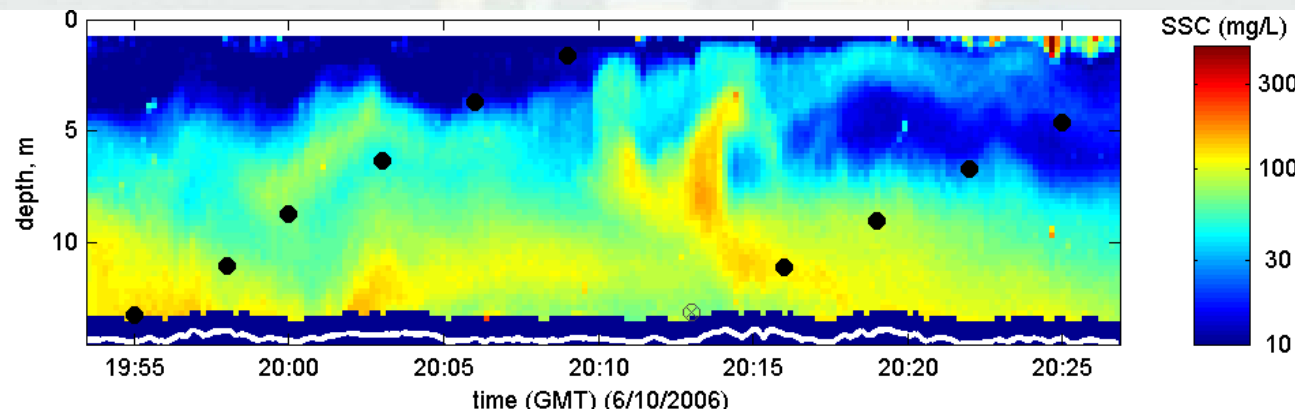
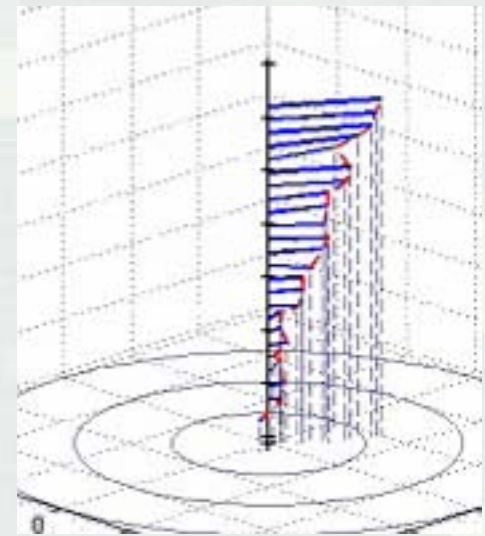
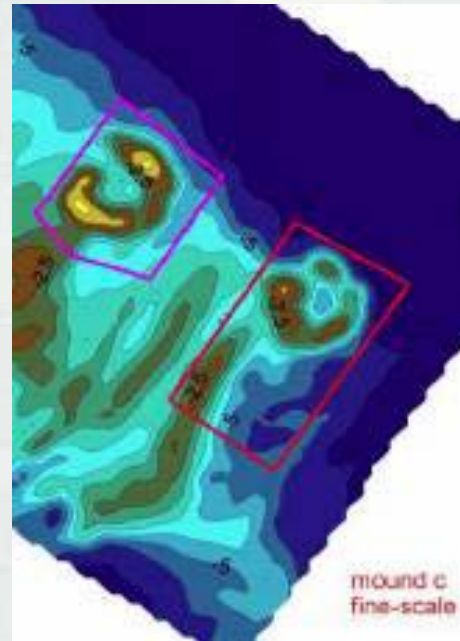
# Concentration, Aggregate States and Settling

- Why make these measurements?
  - Aggregate state influences plume decay, transport distance, and fate of FGS
  - Required for model parameterization, calibration and validation
  - Note: aggregate state can change FGS settling by orders of magnitude



# Monitor Dredging Process

- Direct verification of regulatory compliance (TSS)
- Support development and parameterization of models for dredging process
- Develop input for long-term fate models (initial mound bathymetry and composition)

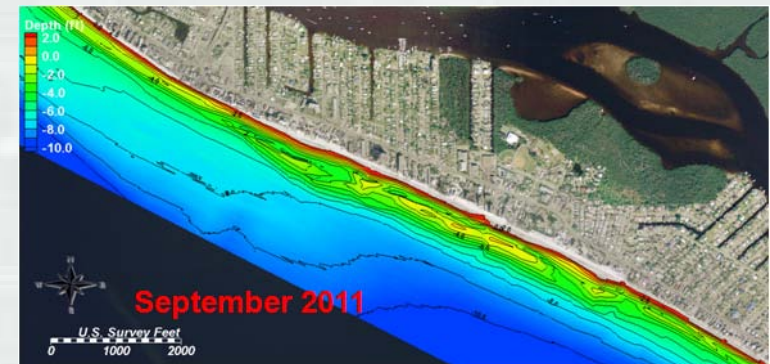
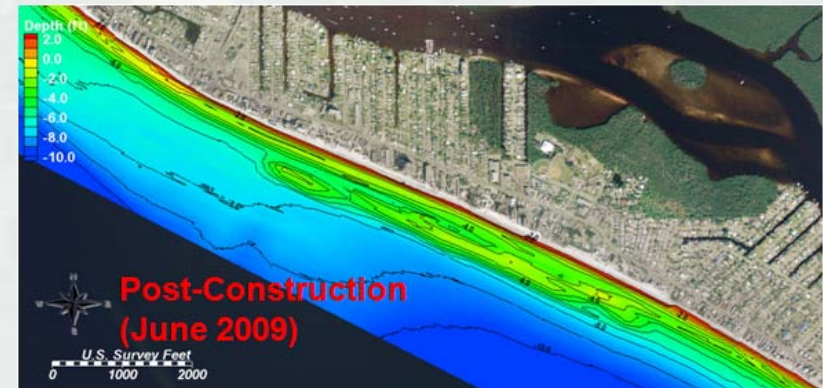
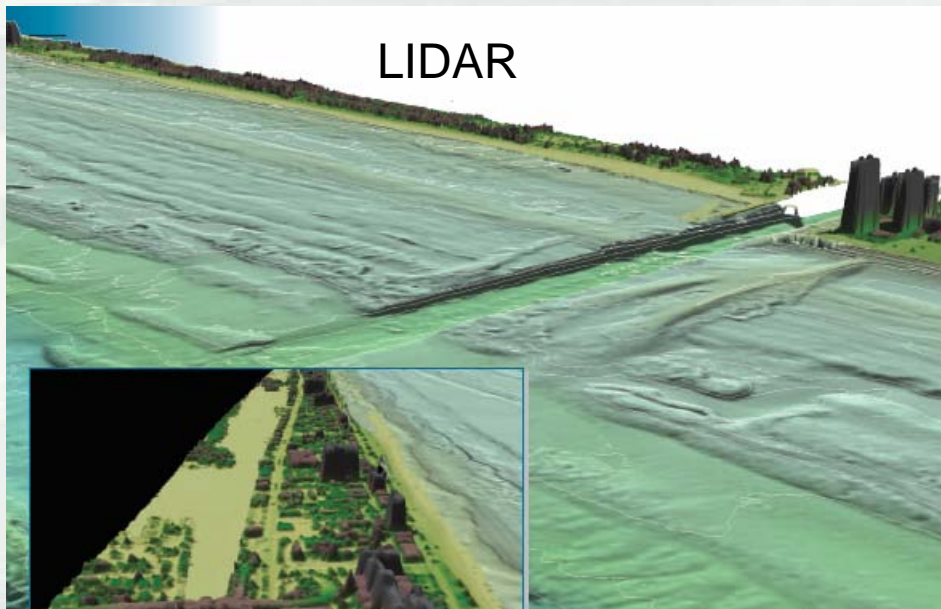


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# Field Measurements Post-Placement

- Repeated surveys – berm/beach morphologic evolution (multibeam, LIDAR, side-scan, beach profile,...)
- GSD of the berm and surrounding area
- Geochemical (natural) tracers
- Manufactured tracers



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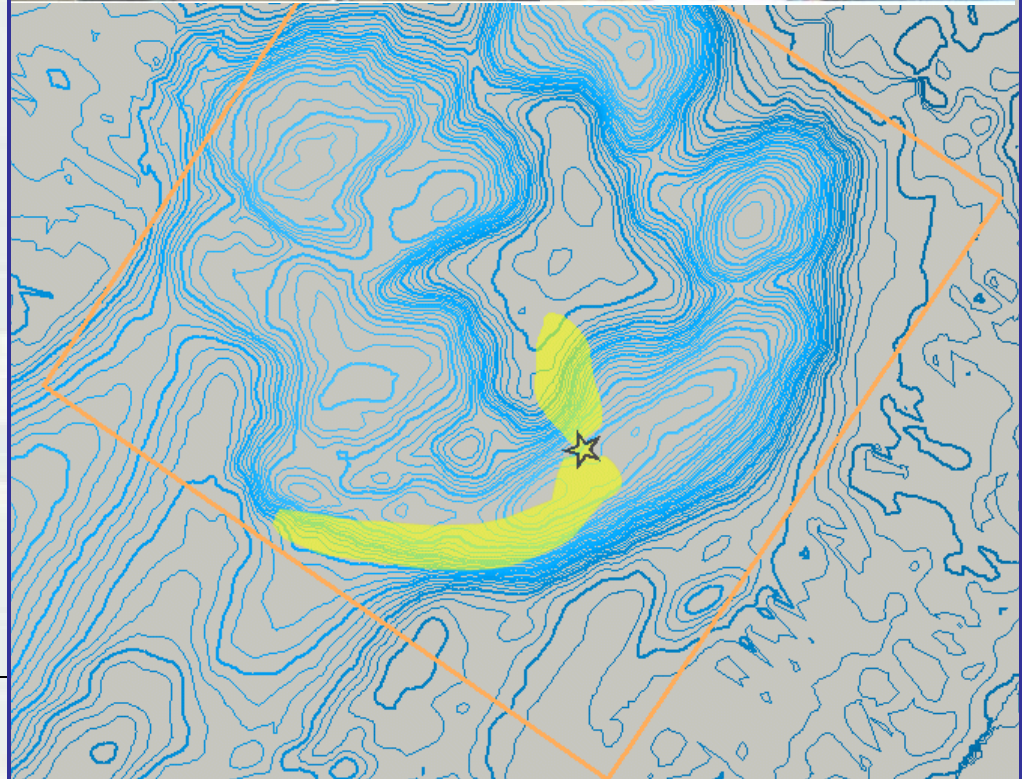
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# Field Measurements Post-Placement

- Geochemical (natural) tracers
  - Use for DM BU is currently being assessed at ERDC
  - Generally used to track fine fraction
- Manufactured tracers
  - Seeding (to represent entire mound) is difficult
  - Generally, represents transport for only a specific set of conditions
  - Difficult to prove a negative
  - Qualitative vs. Quantitative







# Sediment Transport Models Tools for Nearshore Berm Projects



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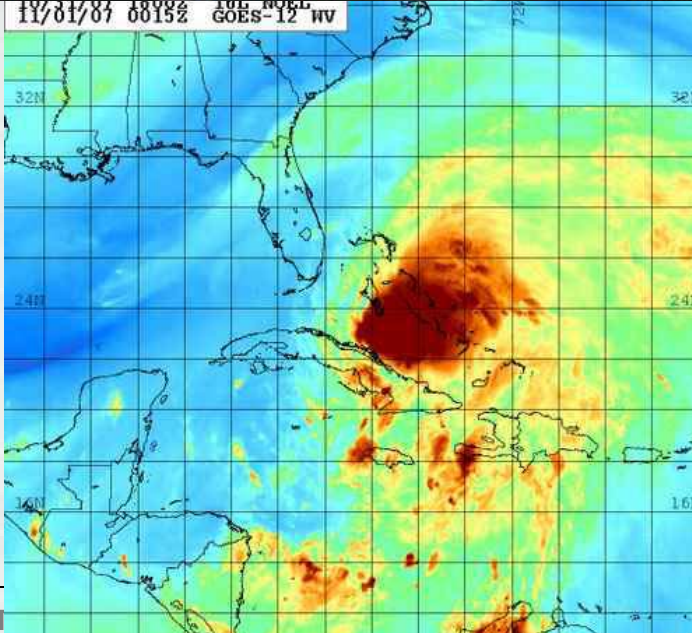


# Transport Modeling Basics

- WHY: Models predict how a system will behave under conditions for which we have limited or no data
  - ▶ Planning
  - ▶ Regulatory approval
- Sediment transport models are based on:
  - ▶ Our understanding of physical processes
  - ▶ General understanding of processes at a site (CSM)
  - ▶ Site-Specific sediment process data
  - ▶ Models must be consistent with all site-specific data
- RSM requires models that accurately predict sediment transport through complex, interconnected regions
  - ▶ Pushing the envelope of transport model capabilities
  - ▶ Must be aware of model limitations
  - ▶ Process research/data collection ongoing



# The Modeling Process



- CSM: Collect relevant historic, hydrodynamic and sediment data
- Select model(s) that will address relevant issues
- Parameterize, calibrate, & validate model using data
- Predict sediment fate for conditions without data
  - ▶ Large events
  - ▶ Post-construction
- Model output/data analysis to support project design





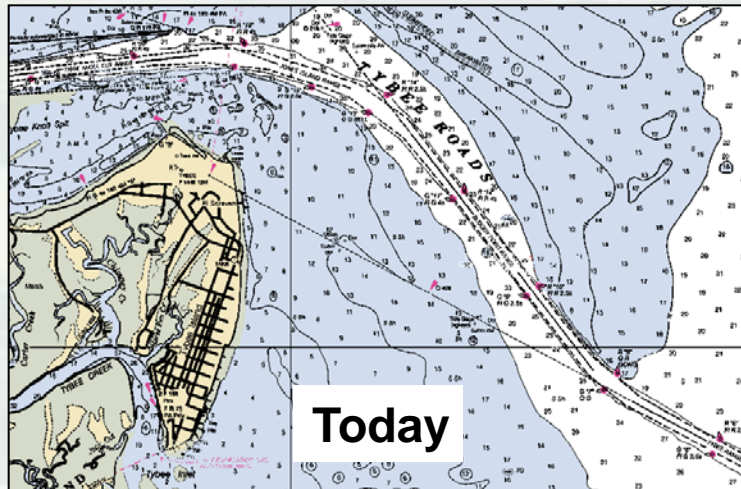
# How Models Support Nearshore Berm Management

- Transport in these regions is inherently complex
- Models are used to address
  - ▶ Regulatory compliance
  - ▶ Environmental Resources/Risk Assessment
  - ▶ Transport from placement site to area of interest
  - ▶ Site/lifecycle management  $\Longrightarrow$  sustainable solutions
  - ▶ Design placement to minimize need for LDC or other expensive handling
  - ▶ Assess alternatives to select cost-effective options
- Models are one of multiple tools (line/lines of evidence)

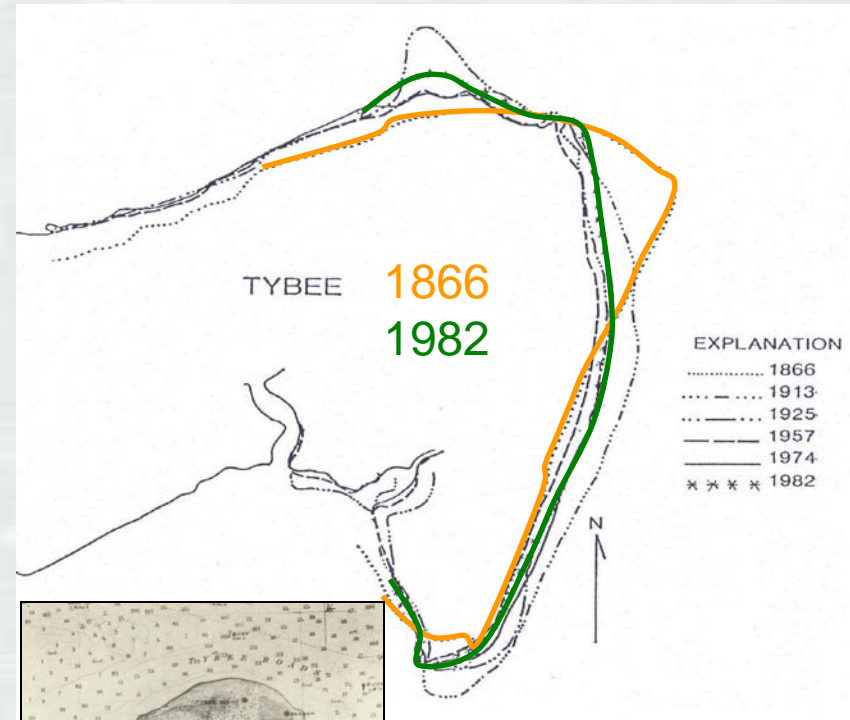




# Savannah Entrance Channel



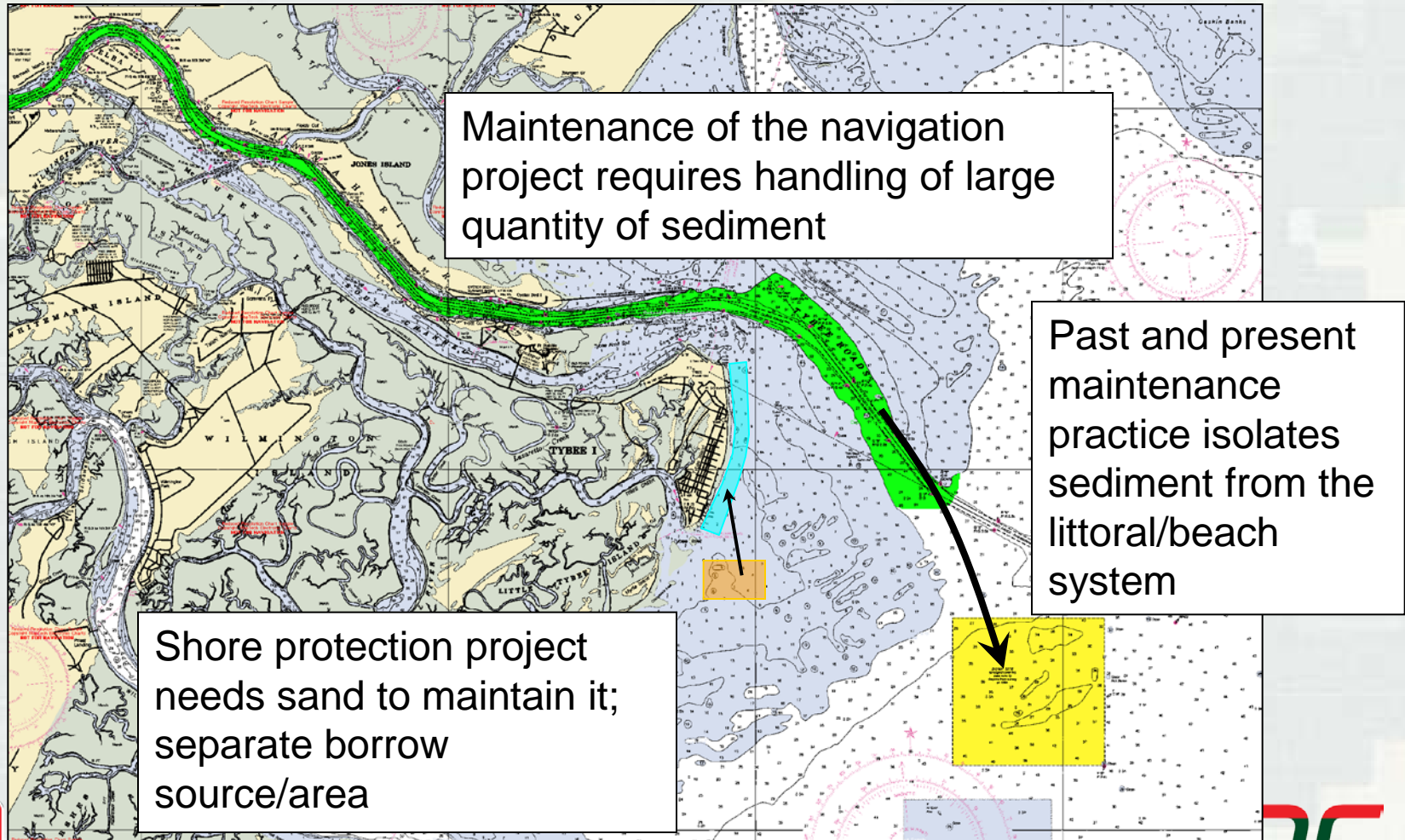
- Federal navigation channel project (jetties and deepened channel)
- Evolving ebb shoal complex and beach erosion problem downdrift of the entrance (on Tybee Island)
- Federal shore protection project constructed to address the erosion
- High sand loss rate on north Tybee, adjacent to the inlet



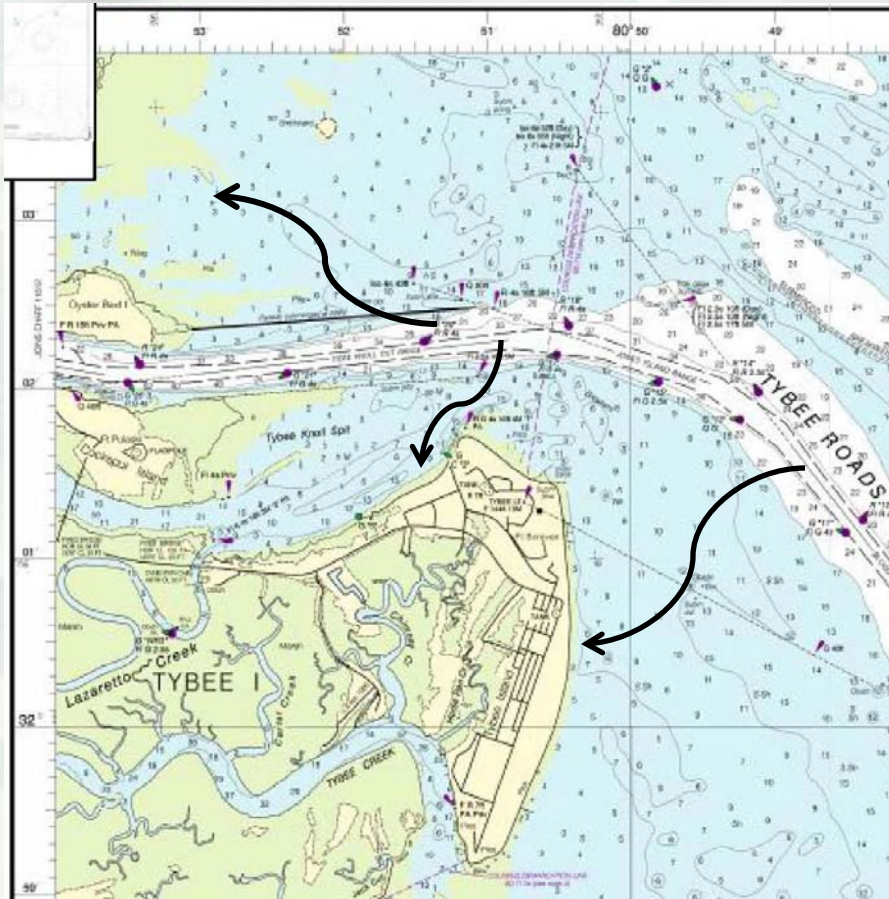




# Project Specific Sediment Management Approach



# Sustainable RSM Solutions



- Many coastal regions are not receiving sufficient sand or fine sediment
- RSM : Strategic mixed sediment placement in nearshore
  - Flood tide moves sediment into wetland
  - Waves move sand toward shore and fines offshore
  - Lower cost than direct placement
  - Sustainable placement sites
  - Natural sorting of mixed sediments
- Use models to assess alternatives and optimize design



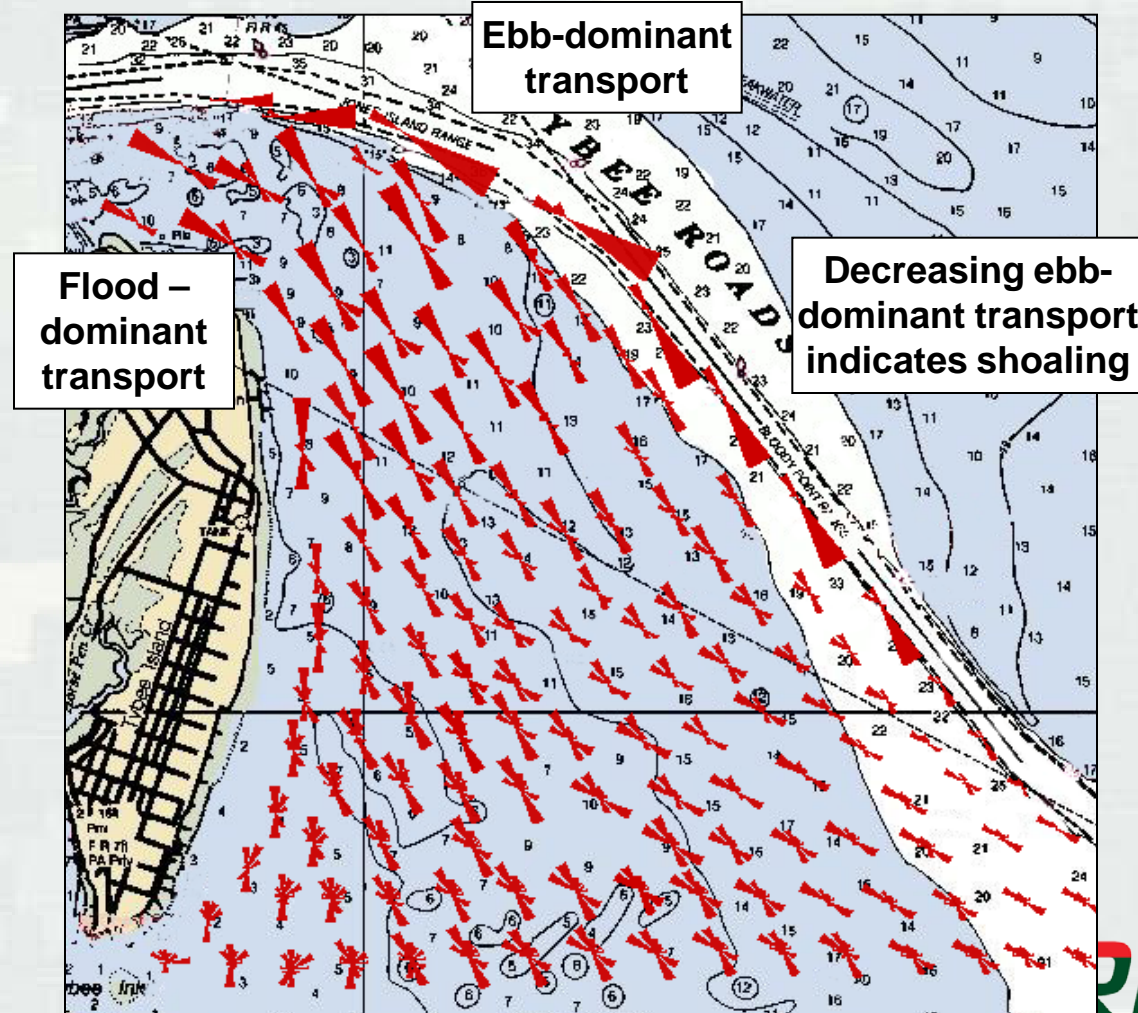


# Sediment transport direction and magnitude for existing natural conditions

- Sediment model results shed light on existing inlet sediment transport processes and pathways, and preferred placement locations

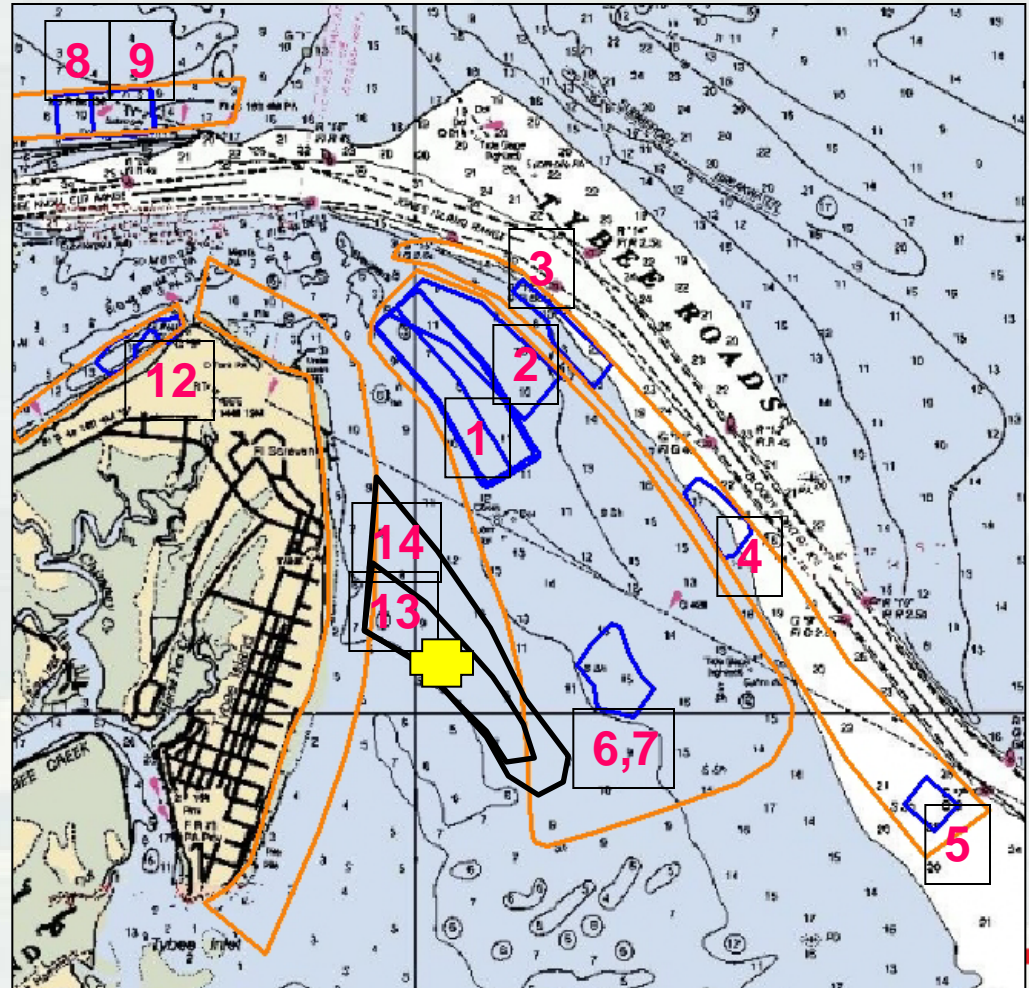
- Results consistent with observed shoaling patterns in the channel and north Tybee

- Results consistent with Brunswick tracer study



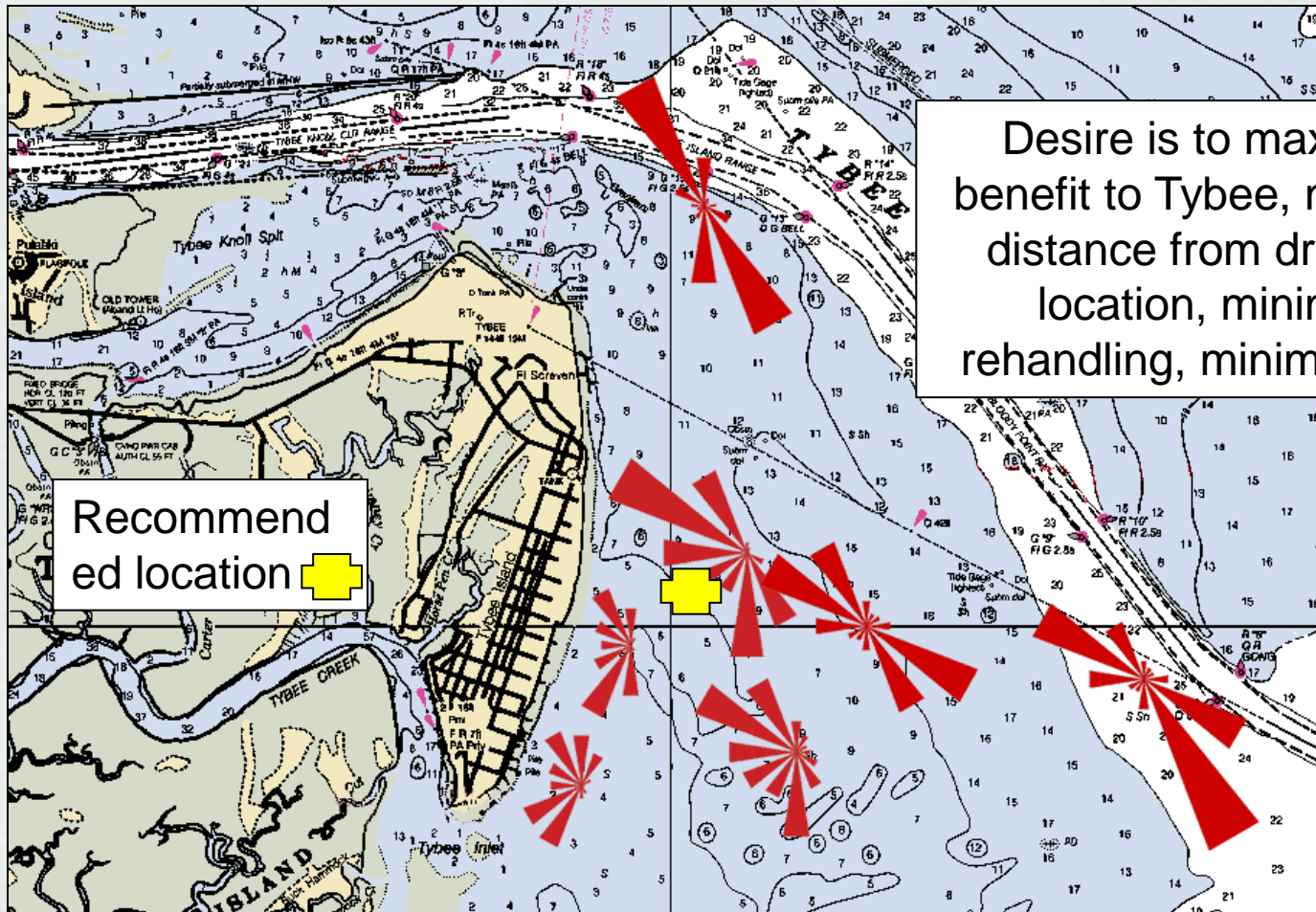
# Proposed Berm Locations

- Multiple berm locations modeled
- New alternatives (13,14) added as result of findings
- Nearshore bathymetric relief influences wave transformation
- Changes in transformation influence longshore transport
- Longshore transport affects shoreline change





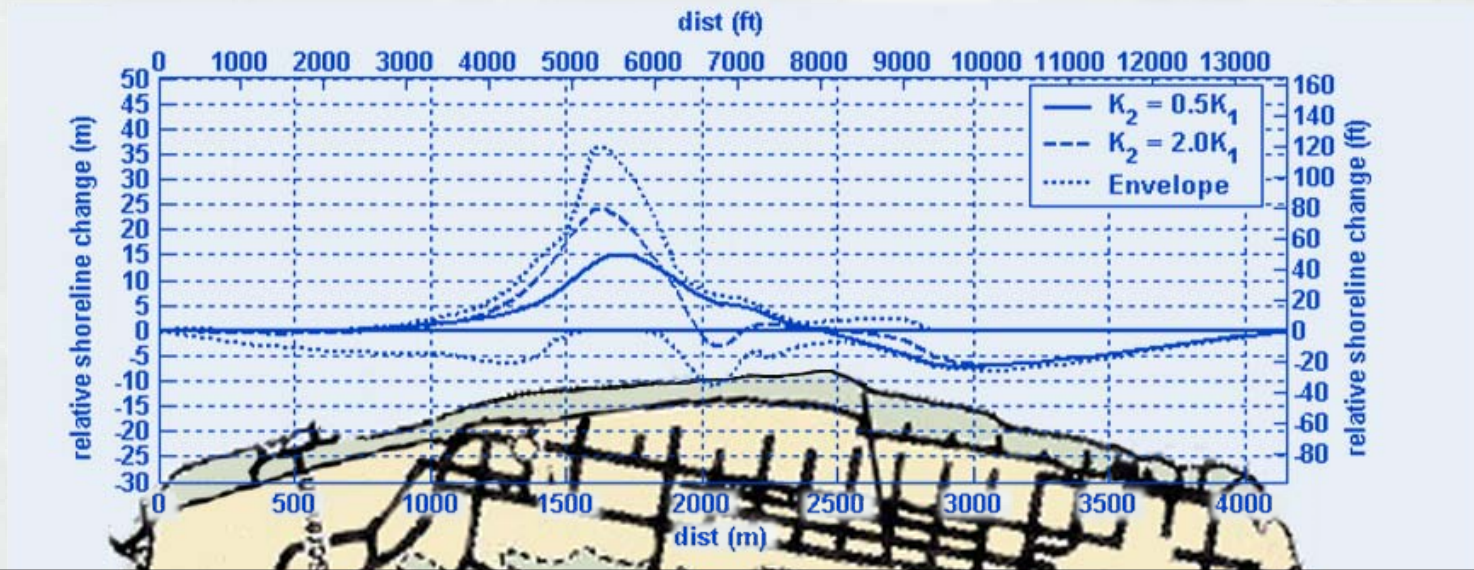
# Sediment transport direction and magnitude at proposed berms







# Relative Shoreline Change Over 20 years, Berm 13 (GENESIS Model Results)



- Negligible negative impacts on the shoreline
- Less than 20-30 ft erosion over 20 years to south Tybee where beaches are healthiest
- Can be offset by future renourishment or occasional modification of nearshore placement practice







# Summary

- Models provide important lines of evidence when developing CSM based on process understanding
- Multiple models and levels of modeling required
- Models require data for parameterization, calibration, and validation
- RSM often requires that we use models to address conditions for which we have no data
- Model benefit to RSM: evaluate options/improve practice





# Examples of Recent Monitoring Projects



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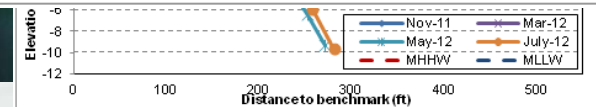
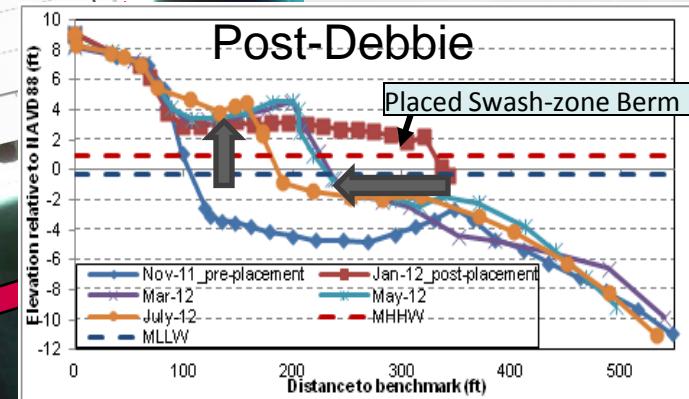
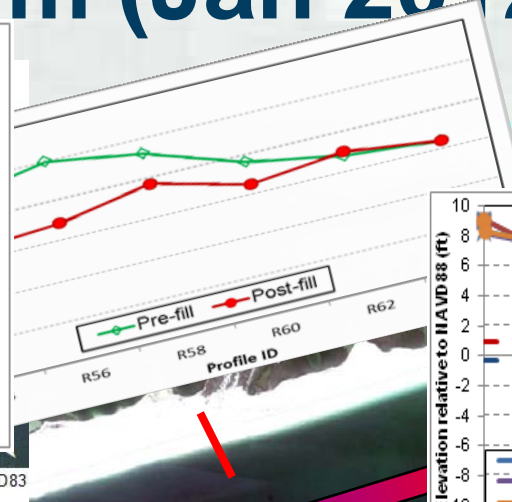
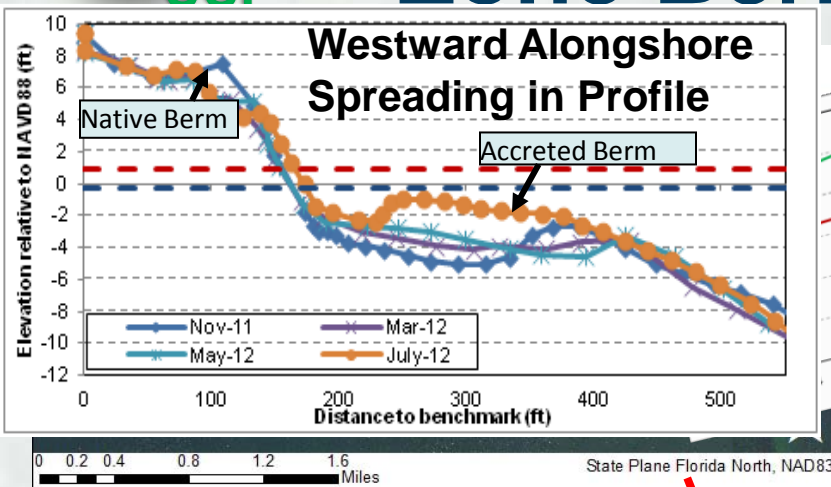
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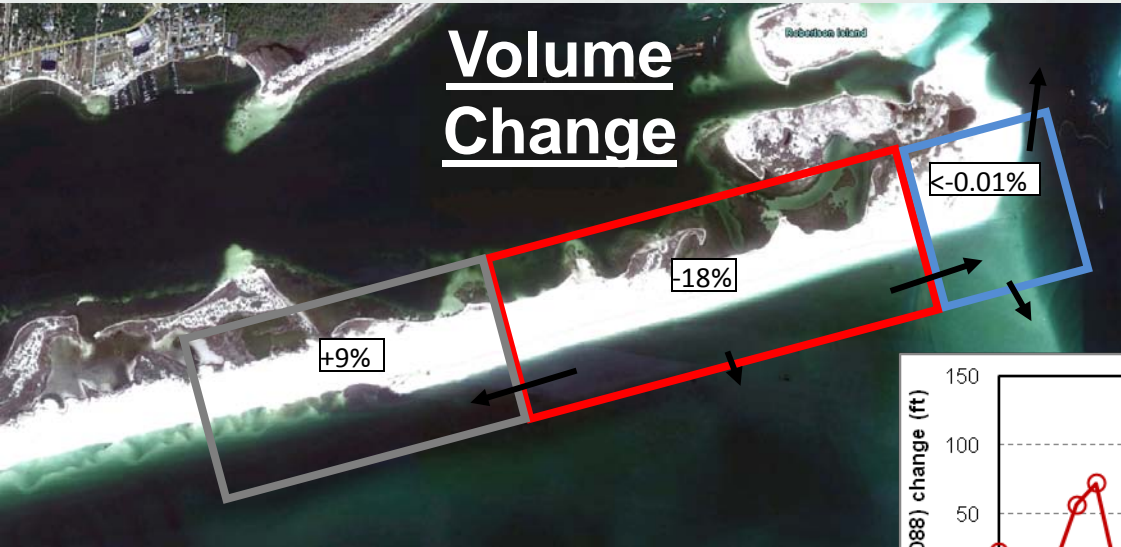
# Perdido Key Swash Zone Berm (Jan 2012)



- Sediment grades coarser away from inlet; fill is uniform inlet material
- Following placement, shoreline erodes landward and shoreface accretes
- Rapid Erosion furthest from the inlet; lowest erosion rates near the ebb shoal
- Alongshore spreading through the nearshore profile
- Inlet shoreline changes not substantial; limited bayside changes

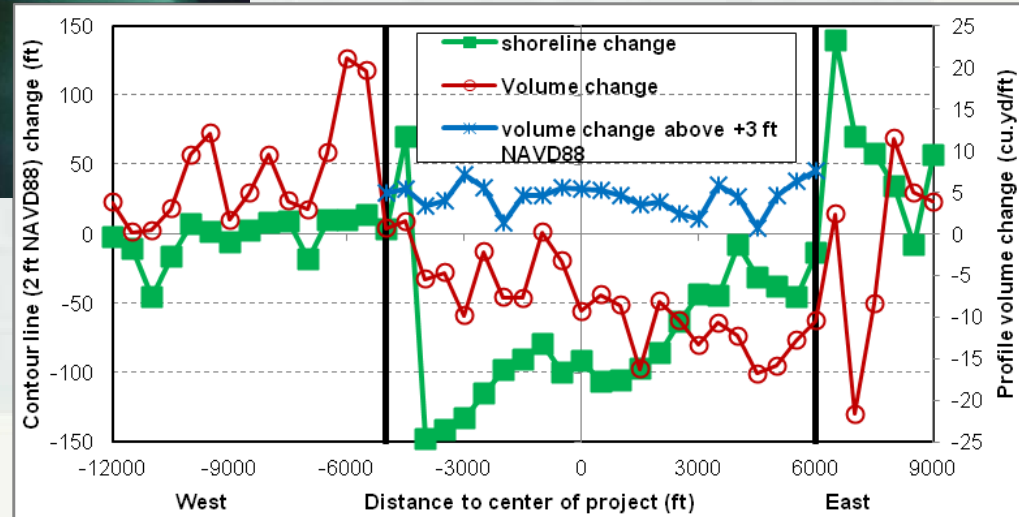


# Perdido Key Swash Zone Berm (Jan 2012)

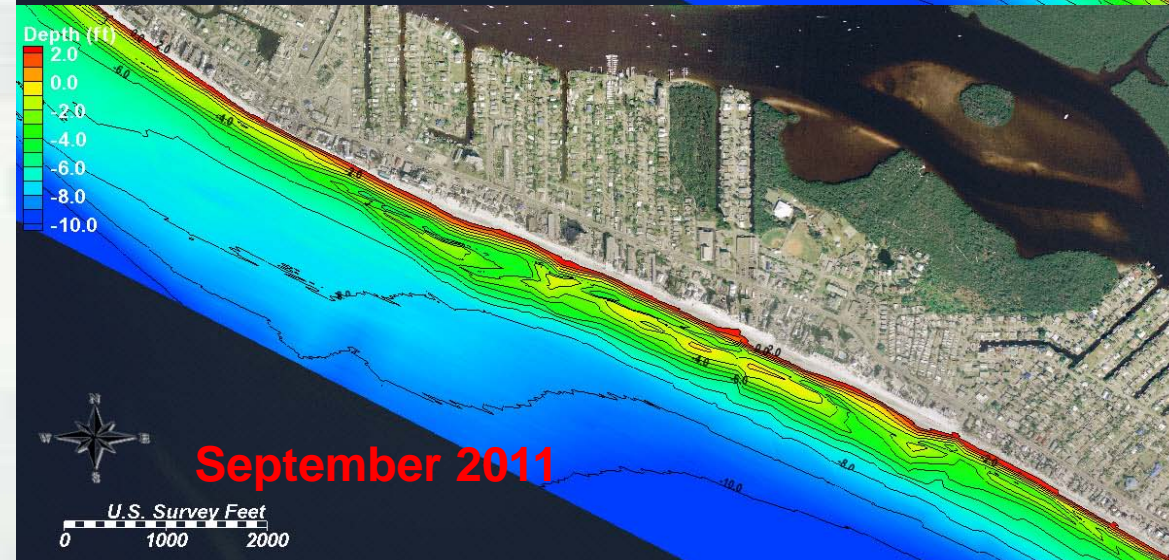
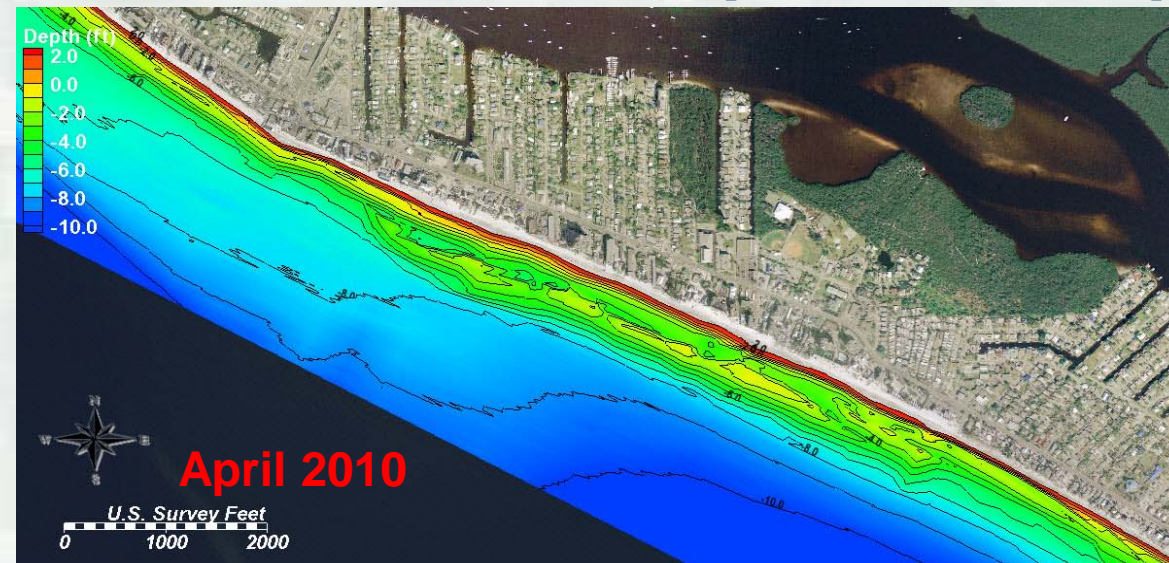


## 6 Month Volume Calculation

- Accurate means of determining sand retention within the nourished area
- Quantitative method to describe the movement of material



# Ft. Myers Nearshore Berm (Jun 2009)



- Fine sediment found in trough and offshore for 1<sup>st</sup> year; 2<sup>nd</sup> year none in trough, and coarsening of berm/trough to native grain size as migrating
- Berm migrated 150 ft/yr; characteristic of an asymmetric onshore migrating bar
- Gaps in berm migrated alongshore, but there was little alongshore spreading
- Negligible effects to the shoreline response (low-wave energy)
- Overall, positively viewed nearshore berm





# New Smyrna Nearshore Berm

**CESAJ**



US ARMY CORPS OF ENGINEERS: ENGINEER RESEARCH & DEVELOPMENT CENTER

**Field Research Facility**

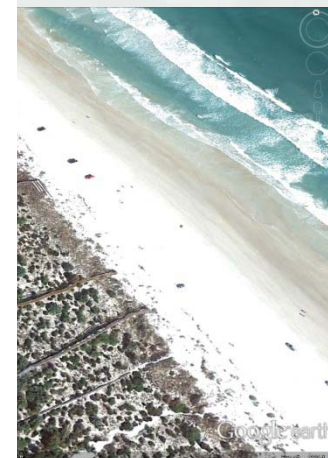
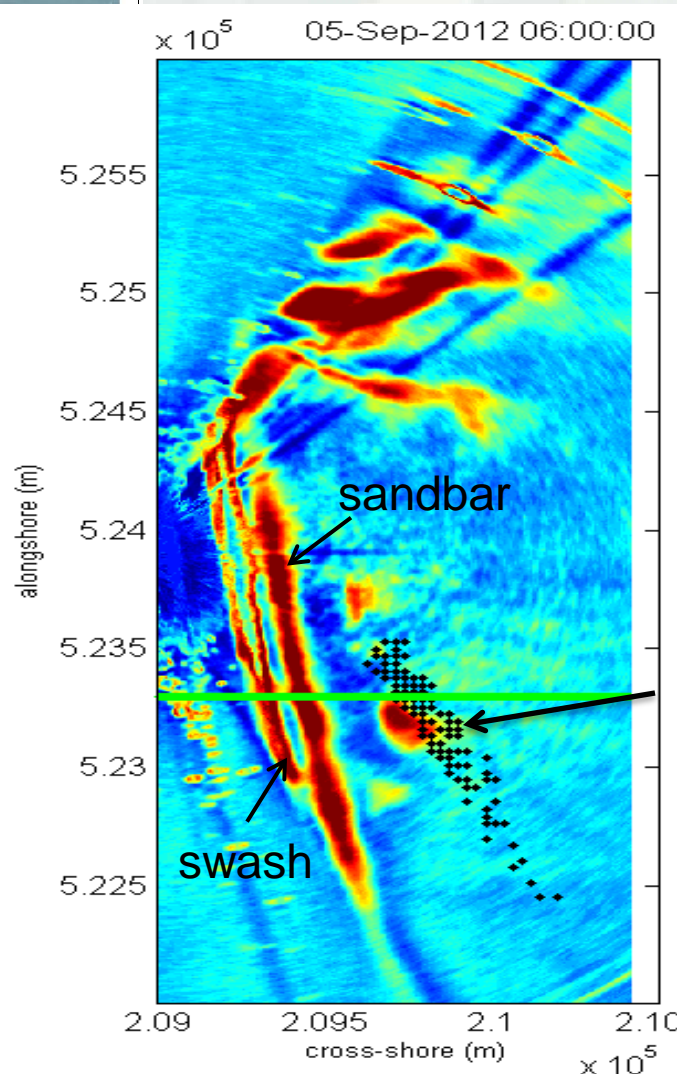
**RADAR INLET  
OBSERVING SYSTEM:**



[www.offshoreswell.com](http://www.offshoreswell.com)



	<b>WQC PLATES</b>	FILE NAME:	OWN BY:	GENERAL NOTES:
	NOT FOR CONSTRUCTION		CMK	
	DEPARTMENT OF THE ARMY	DATE:	REV BY:	
	JACKSONVILLE DISTRICT, CORPS OF ENGINEERS	REASON:	DATE BY:	
	JACKSONVILLE, FLORIDA	AS SHOWN	SR	



Placement  
locations



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# New Smyrna Nearshore Berm

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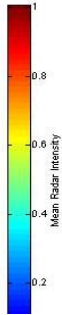
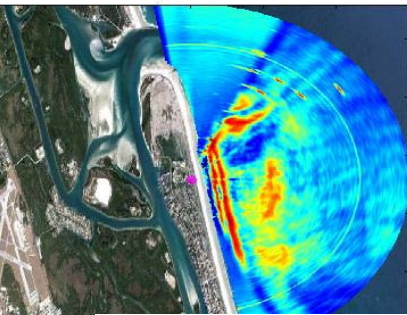
## RADAR INLET OBSERVING SYSTEM:

Remotely acquired waves,  
currents, and bathymetry

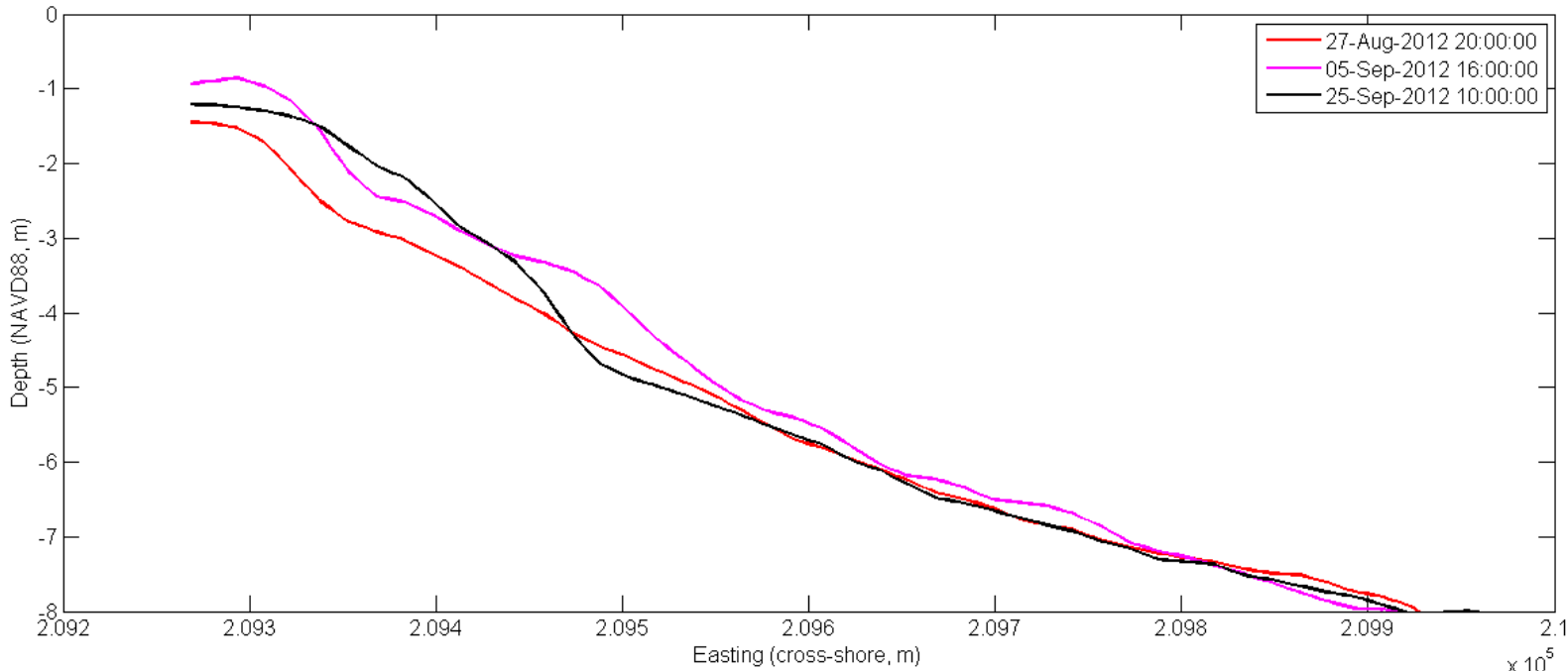
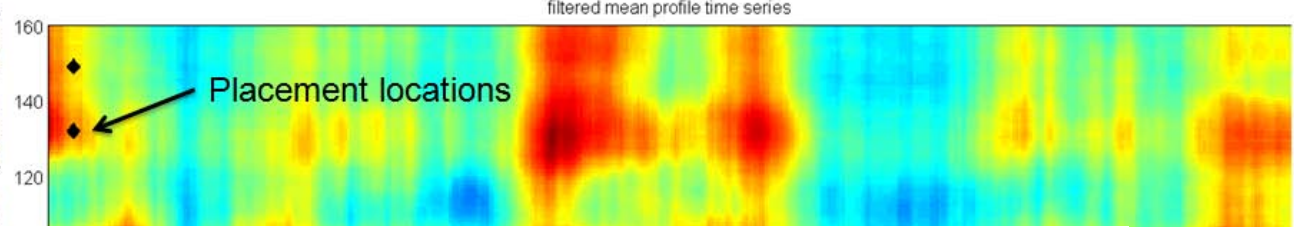


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25-Sep-2012 10:00:00



ice (units x5m)





# Discussion



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# Potential Discussion Topics Related to Presentation

- ❖ Acquiring permitting for new nearshore placement sites
  - ❖ Guidance on defining active berm placement zones
- ❖ Direct measurements to meet Regulatory Needs
  - ❖ Sand Rule & turbidity issues
  - ❖ Need for pre-placement measurements
- ❖ Modeling
  - ❖ A proxy for measurements to acquire permits
  - ❖ Confidence with inclusion of measurements
  - ❖ Are simple or sophisticated numerical models desired by Districts, Stakeholders, or Regulators?





# Potential Discussion Topics Related to Active Nearshore Berms

- ❖ What type of design guidance do District folks want? A Hands and Allison upgrade, or numerical modeling?
- ❖ Influence of type of placement method – hopper or pumped
- ❖ Existing guidance excludes currents (tidal), an important factor for most placements near navigation channels – how to address?
- ❖ How temporal and spatial scales of longshore/cross-shore evolution are defined, monitored, and included in permitting

